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WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

E. A. BIRGE, Director
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SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE
H. L. RUSSELL, Dean

BULLETIN NO. 53--A SOIL SERIES NO. 20

# SOIL SURVEY

OF

# DANE COUNTY

## WISCONSIN



BY
A. R. WHITSON, W. J. GEIB, AND G. W. CONREY
OF THE
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
AND
ARTHUR E. TAYLOR
OF THE
UNITED STATES DEPARTMENT OF AGRICULTURE

SURVEY CONDUCTED IN COOPERATION WITH THE UNITED STATES
DEPARTMENT OF AGRICULTURE BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

MADISON, WISCONSIN
PUBLISHED BY THE STATE
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# Wisconsin Geological and Natural History Survey

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# INTRODUCTION.

Before the greatest success in agriculture can be reached, it is necessary that the farmer should have a thorough knowledge of the soil upon his own farm. A soil may be well adapted to one crop, and poorly adapted to another crop. Clover will produce a vigorous growth and profitable yields on the average loam soil which contains lime and is in a sweet condition; but on a sandy soil which is sour, or in an acid condition, clover will not make a satisfactory growth. We may say, therefore, that failure is certain to be invited when such important facts are disregarded, or overlooked. The degree of success which it is possible to win on any farm is in direct proportion to the practical knowledge possessed by the farmer concerning the soil and its adaptation to crops. A thorough knewledge of the soil is as essential to the farmer as a knowledge of merchandise and business methods is to the merchant.

The State of Wisconsin, working in cooperation with the United States Department of Agriculture, is making a careful study of soils and agricultural conditions throughout Wisconsin, and is preparing soil maps and soil reports of all counties in the State. A soil map shows the location and extent of the different kinds of soil. Tracts of 10 acres and over are mapped, but often areas of even smaller extent are shown. The soil map is prepared by trained men who go over a county thoroughly, and examine the soil by making a sufficient number of borings to a depth of 36 inches to keep account of all variations. On this map boundaries between different soils are shown with black lines, while water courses, such as creeks, rivers and lakes, are in blue. The elevation of various localities is indicated with brown lines which are drawn through points of equal elevation. The difference in elevation between points on two adjacent lines is 20 feet. A report is also made, to accompany and explain the map, and this is based upon a careful study of the soils within the region surveyed, and upon such

other features as have a direct bearing upon the agriculture of the area.

It is the object of this survey to make an inventory of the soils of the State, and to be of practical help to farmers by locating and describing the different soils, by determining their physical character and chemical composition, and by offering suggestions for their management, based upon the work of the Soil Survey within the area, covered in the report and upon the results of field tests made by the Experiment Station.

Soil fertility depends upon two factors: first upon the physical characteristics of the soil, such as water holding capacity, work-ability, etc., and second, upon the chemical composition of the material composing the soil. The chemical composition depends upon the mode of origin of the soil, and the source of material from which the soil is derived.

Water holding capacity, and other physical properties of soil depend chiefly upon *texture,* which refers to the size of the individual soil grains or particles. A coarse sandy soil, for example will not retain moisture so long as a loam soil or clay loam because the finer the soil grains the greater will be the total soil grain surface area to which moisture may adhere. Texture is determined in the field by rubbing the soil between the thumb and fingers and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a mechanical analysis which is made by a simple method of separating soil grains into different groups of which there are seven. These are known as clay, silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel

A chemical analysis is also made of the soil to determine the amounts of various essential plant-food elements which are present. A chemical analysis shows whether the soil contains a large store of plant food, or only a small quantity, and it indicates which kinds of plant food will probably be needed first. The amount of organic matter in the soil is also determined, and tests are made to show conditions relative to soil acidity.

## SOIL CLASSIFICATION.

Soils are grouped according to texture into soil classes, a soil class being made up of soils having the same texture, through differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

### SOIL CLASSES

SOILS CONTAINING LESS THAN 20% SILT AND CLAY

**Coarse sand.**—Over 25% fine gravel and coarse sand, and less than 50% of any other grade of sand.

**Sand.**—Over 25% fine gravel, coarse and medium sand, and less than 50% fine sand.

**Fine sand.**—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.

**Very fine sand.**—Over 50% very fine sand.

SOILS CONTAINING BETWEEN 20-50% OF SILT AND CLAY

**Sandy loam.**—Over 25% fine gravel, coarse and medium sand.

**Fine sandy loam.**—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.

**Sandy clay.**—Less than 20% silt.

SOILS CONTAINING OVER 50% OF SILT AND CLAY

**Loam.**—Less than 20% clay, and over 50% silt.

**Silt loam.**—Less than 20% clay, and over 50% silt.

**Clay loam.**—Between 20 and 30% clay, and less than 50% silt.

**Silty clay loam.**—Between 20 and 30% clay, and over 50% silt.

**Clay.**—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a graduation in texture of otherwise uniform material, such a group is called a *soil series.* It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for examples, includes light colored, glacial material

where the soils have been derived largely from the underlying limestone. The Plainfield series includes light colored soils in regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash plains or stream terraces. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil Survey.

By uniting the name of the *soil class* which refers to texture, with the name of the *soil series* which refers chiefly to origin, we get the *soil type* which is the basis or unit of classifying and mapping soils. A *soil type* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural unity, that is being adapted to the same crops, and requiring the same treatment. It is also uniform in the source of material from which it is derived, and the mode of origin which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils, and the basis upon which experimental work should be conducted, every farmer should be familiar with the soil types on his farm, and their leading characteristics.

# SOIL SURVEY OF DANE COUNTY, WISCONSIN

## CHAPTER I.

### GENERAL DESCRIPTION OF THE AREA.

Dane County is located in the southern part of Wisconsin, about midway between the Mississippi River and Lake Michigan. It has a total area of 1,202 square miles or 769,280 acres.


FIG. 1.—Sketch map showing area surveyed.

The topography is quite variable in different parts of the county. Southwest of a line running thru Cross Plains and Brooklyn it is that of a plain into which many valleys have

been cut by streams. This part of the county is rolling to rough and hilly, and is marked by undulating to rolling ridge lands, steep valley walls with numerous rock ledges outcropping, and rather narrow valley bottoms. Military Ridge, lying just south of Blue Mounds and Mount Horeb, has a rolling topography, and divides the drainage of this portion of the county, the streams to the south flowing into the Rock River, and those to the north into the Wisconsin.

In marked contrast to this western portion of the county is the central and eastern part, where the hills are more or less rounded and long steep slopes are almost lacking. In the north and southeastern parts of the county there are broad areas of undulating to gently rolling prairies. To the east there are numerous rounded hills or ridges with their long axis usually lying in a common direction—northeast and southwest. Narrow gravel ridges and small knolls occur through this portion of the county giving in places a rough, bumpy topography. Such areas are of limited extent, and while widely scattered are most numerous in the southeastern sections. Level tracts of land varying in size from a few acres to 5 square miles, with underlying gravel beds are of common occurrence. Between the hills and ridges are often level marsh areas which mark the sight of former lakes and ponds.

The natural drainage of Dane County is closely related to the topography, being perfectly developed in the western part where there are many drainage channels, and imperfectly developed in the central and eastern portions where the drainage waters have comparatively few channels for their outlet. Furthermore in the western part there are very few marshes, while in the eastern portion marshes are in great abundance.

The first white men to enter this general region were hunters and trappers, who reached the country by way of "The Portage" and the Wisconsin River. The first permanent settlers were lead miners. About 1830 homeseekers came in to take up land for farming purposes. The first settlers of this class were largely from Illinois, Ohio, and the New England states. Following these there was a great influx of Germans and Norwegians, and at present the population is made up largely of people of foreign extraction, including Germans, Norwegians, Irish, English, and a number of other nationalities. The county was set off from parts of Iowa and Milwaukee Counties

in 1836, but was not organized as a separate county until 1839. The population of Dane County is reported in the 1910 census as 77,435, and is quite evenly distributed.

Madison, the capitol of the State, is the county seat of Dane County. Its population is given as 25,531 in the 1910 census. Madison is a railroad and manufacturing center of considerable importance. The University of Wisconsin and the Agricultural Experiment Station are located here. Stoughton, with a population of 4,761, is the second city in size. It has extensive wagon-manufacturing interests, and is the center of a highly developed farming section. Other towns and villages of importance are Sun Prairie, Mount Horeb, Mazomanie, Middleton, Marshall, Waunakee, De Forest, Belleville, Cross Plains, Dane, Verona, Blue Mounds, Morrisonville, Windsor, Cottage Grove, Macfarland, London, Klevenville, Riley, Basco and Burke.

Dane County is exceptionally well provided with transportation facilities. Lines of three railroad systems serve the county, radiating in all directions from Madison. The main line of the Chicago & Northwestern Railway crosses the county from northwest to southeast. From Madison one branch of this line extends west along the "Military Ridge" and another branch extends east to Milwaukee. A line of the Chicago, Milwaukee & St. Paul Railway crosses the county from east to west and joins the main line at Watertown, Jefferson County. From Mazomanie a branch runs north to Sauk City and Prairie du Sac. Another line runs north from Madison to Portage and another southeast from Madison to Chicago. A branch of the Illinois Central Railroad extends from Freeport, Ill., to Madison.

The towns within the county provide a ready market for farm products and are shipping points from which large quantities of produce are sent to outside markets. Most of the live stock is shipped to Chicago or Milwaukee. The Lake cities constitute good markets for all products of the farm, dairy, and garden.

The wagon roads throughout the county are, as a whole, in good condition, and each year large sums are expended in road improvement. Through the assistance of the State, roads made of crushed rock are being constructed in various parts of the county. All parts of the county are supplied with the rural delivery of mail and telephones are in common use.

## SOILS.

Dane County includes several distinct geological formations, and all of these have contributed to a greater or less degree to the material from which the various soil types have been derived. The oldest formation within the area is the Potsdam sandstone, which forms the surface rock in the valley of the Wisconsin River and in parts of the valleys of tributary streams in Dane, Berry, and Cross Plains Townships. It also forms the surface rock over a part of the Catfish or Yahara Valley, but in this instance the formation is represented only by the uppermost layers, the Mendota limestone and Madison sandstone.

Over the Madison sandstone is found the Lower Magnesian limestone, which forms the surface rock over the principal divide between the Wisconsin River and its tributaries on the west and the Yahara and Sugar Rivers on the east. Outcrops of this rock occur frequently along the valley walls of these streams and their tributaries. It is also the surface rock over most of the eastern half of the county.

Immediately over the Lower Magnesian limestone is the St. Peters sandstone, which outcrops frequently along the steep valley walls throughout the western and southwestern sections of the county, and also occurs in scattered areas in the eastern part.

The Trenton and Galena limestone constitute the surface rock in the elevated ridges between Blue Mounds and Mount Horeb, and south to the Green County line.

A large part of the county has been modified by the action of moving ice—the glacier—which formerly covered a large portion of Wisconsin along with nearly all of northeastern North America. In moving over the country the sheet of ice ground down hill tops, filled in the valleys and mixed much ground up rock with the original soil. As the ice melted vast quantities of sand, clay and gravel were dropped down, and streams formed by the melting ice carried immense quantities of sand and gravel and formed broad flood or outwash plains. Some of the material carried along by the ice was brought for long distances, and in this way boulders unlike the local rocks were brought in. The material deposited by the ice is often called till or drift. In Dane County the area which has been glaciated

may be roughly separated from that which was not glaciated—the Driftless area—by a line extending from the northwestern corner of the county through Cross Plains and Verona to a point 1½ miles east of Bellville. The glaciated region lies to the east of this line. Within a triangle, with the towns of Verona, Belleville and Brooklyn at the angles there is an area which has been covered by the pre-Wisconsin or earlier stage of glaciation. This area has more of the appearance of an unglaciated or driftless region rather than a glaciated one. The presence of scattered boulders and gravel which are not of the same kind of rock as that underlying this section is about the only sign that the glacial ice covered this portion of the county. The remainder of the glaciated portion of the county was covered by the late Wisconsin ice sheet, the last invasion of the ice. Many of the soils of the county have been derived from the glacial deposits.

The soils of Dane County have been grouped into 13 series and 31 types, including Rough stony land, Madeland, Peat, Muck, and Meadow.*

The Miami series is one of the most important, both in extent and agricultural value. It includes all the light-colored forested upland where the soils have been derived from unstratified glacial limestone till.

The Carrington series is also important in this county. The Miami and Carrington series include a large part of the best agricultural land in Dane County. The Carrington series comprises all the dark-colored prairie upland soils which are derived from the weathering of unassorted glacial limestone till.

The light-colored, waterlaid, forested soils of the glaciated limestone region are classed with the Fox series. The material has been very largely carried out by streams formed by the melting of the glacial ice and deposited in level stream terraces and outwash plains.

The Plainfield series includes glacial or terrace soils which do not contain lime—are not calcareous. Although in this county much of the material originally came from a limestone region, through its transportation by moving water most of the lime has been removed.

*The names of the various soil types used in this report are not in all cases the same as the names used in the original soil report published by the United States Bureau of Sails. The following table indicates the changes which have been made.

The Waukesha series includes dark-colored prairie or semi-prairie soils which have been derived from reworked glacial material and deposited in the form of glacial outwash plains and stream or lake terraces.

The Knox series includes the light-colored forested upland soils of the unglaciated portion of the county, where the soil has been largely formed thru the wearing down of limestone by the action of water, in dissolving out the more soluble portions of the rock, by the frost, and other processes forming residual soils. Portions of the soil of this series are extremely silty or loessial in nature and probably are of wind blown origin. This is the most extensive and important series in the unglaciated—the driftless—section of the county.

The Dodgeville series includes the dark-colored upland prairie soils of the unglaciated portion of the county, where the material probably is partly loessial and partly residual from limestone, which occurs at a depth of 2 to 10 feet. The soils of this series constitute good farm lands, except where the soil is shallow.

The Boone series embraces the light-colored residual soils of the unglaciated region, derived largely from the weathering and distintegrating of sandstone.

The dark-colored soils of the unglaciated region, where the soils are alluvial or stream deposits and occur as first-bottom land, are classed with the Wabash series. They are subject to overflow and require drainage.

Dark-colored poorly drained soils within the glacial region, and which are calcareous—contain lime—are included with the Clyde series. These soils occupy old glacial-lake beds, ponded valleys, or bottom land along the streams.

Similar dark-colored poorly drained soils which are not calcareous are classed with the Dunning series.

The Genesee series includes light-colored alluvial soils which occur as first bottom lands and are subject to overflow.

| Name used in the Bureau of Soils report. | Name used in the present report. |
|---|---|
| Miami gravelly fine sandy loam. | Miami gravelly sandy loam. |
| Carrington silt loam. | Carrington silt loam, shallow phase. |
| Carrington silt loam, deep phase. | Carrington silt loam. |
| Waukesha silt loam, low terrace phase. | Dunning silt loam. |
| Waukesha fine sandy loam, low terrace phase. | Dunning fine sandy loam. |
| Union silt loam. | Knox silt loam. |
| Union silt loam, steep phase. | Knox silt loam, steep phase. |
| Crawford silt loam. | Dodgeville silt loam, shallow phase. |
| La Crosse silt loam. | Wabash silt loam, terrace phase. |

The Rodman soils consist of light-colored stratified glacial material, and occur as gravelly knolls and ridges. This series is not extensively developed in Dane County.

Rough stony land includes areas of steep, rocky slopes, where the land is too steep or too rocky to be of value for cultivated crops. These areas may be considered as nonagricultural.

Madeland includes small areas where the surface soil has been deposited by artificial means. It consists mainly of poorly drained areas which it has been desirable to fill in for building purposes.

Peat consists of vegetable matter in varying stages of decomposition, with which there may be incorporated a small amount of mineral matter. It occupies old lake beds, marshes, and poorly drained depressions.

Muck includes soils high in organic matter and intermediate between Peat and the soils of the Clyde series.

Meadow includes first-bottom land which is low, poorly drained, and subject to overflow. The texture is so variable that no separation into established types can be made.

The following table gives the name and the actual and relative extent of each of the soils mapped in Dane County.

*Areas of Different Soils*

| Soil | Acres | Per cent |
|---|---|---|
| Miami silt loam | 154,752 | 32.9 |
| Deep phase | 98,752 | |
| Carrington silt loam | 79,296 | 18.2 |
| Shallow phase | 60,736 | |
| Knox silt loam | 79,872 | 12 3 |
| Steep phase | 15,104 | |
| Peat | 52,288 | 6.8 |
| Dodgeville silt loam | 32,640 | 5.2 |
| Shallow phase | 7,424 | |
| Clyde silt loam | 37,184 | 4.8 |
| Wabash silt loam | 16,064 | 3.6 |
| Colluvial phase | 9,216 | |
| Terrace phase | 2,176 | |
| Boone fine sandy loam | 21,056 | 2.7 |
| Fox silt loam | 17,600 | 2.3 |
| Waukesha silt loam | 12,480 | 1 6 |
| Miami fine sandy loam | 12,480 | 1.6 |
| Rough stony land | 10,752 | 1.4 |
| Miami gravelly sandy loam | 10,368 | 1 3 |
| Muck | 8,448 | 1.1 |
| Waukesha fine sandy loam | 6,208 | .8 |
| Fox fine sandy loam | 4,864 | .6 |
| Clyde fine sand loam | 3,712 | .5 |
| Carrington fine sandy loam | 3,584 | .5 |
| Plainfield fine sand | 1,984 | .2 |
| Dunning fine sandy loam | 1,728 | .2 |
| Rodman gravelly sandy loam | 1,536 | .2 |
| Boone loam | 1,408 | .2 |
| Meadow | 1,344 | .2 |
| Fox loam | 960 | .1 |
| Wabash loam | 960 | .1 |
| Madeland | 768 | .1 |
| Miami loam | 512 | .1 |
| Clyde loam | 320 | .1 |
| Dodgeville fine sandy loam | 128 | .1 |
| Genesee fine sand | 128 | .1 |
| Total | 769,280 | |

# CHAPTER II.

## GROUP OF HEAVY, LIGHT COLORED UPLAND SOILS.

### MIAMI SILT LOAM

*Extent and distribution.*—Miami silt loam, with its deep phase, is the most important type in the county. The typical soil is distributed throughout the eastern two-thirds of the county and is closely associated with its deep phase, with Miami fine sand loam, and with soils of the Carrington series. The most extensive areas occur in Medina, Middleton, Springfield, Dane, Berry, and Roxbury Townships. With its deep phase, this type covers almost one-third the county.

*Description.*—The surface soil of Miami silt loam has an average depth of 10 to 12 inches. It consists of a light-brown silt loam, which frequently has an ashen appearance when dry. There is often present in the soil a small amount of fine gravel, and in places a few stones occur on the surface. Where the content of silt is highest this soil is usually free from gravel and small stone and resembles those extremely silty soils called loess soils. In such places it is also deeper than where fine sand and gravel is mixed with the silt. Where the surface soil is the most silty or loess-like and of considerable depth a deep phase is indicated on the soil map.

The subsoil of the typical Miami silt loam consists of a brown or yellowish-brown silty clay loam which gradually becomes lighter in color, and in some cases lighter in texture, with depth. Where the soil is extremely silty it may continue quite uniform and almost stone free to a depth of two feet, where occurs an abrupt changes to mixed glacial material consisting of silty clay, sand and gravel. In much of this type however, there is some gravel and sand throughout the entire subsoil, which grades from a silty clay loam into a heavy fine sandy loam or even a fine sand at 30 to 36 inches. The lower subsoil usually contains a large quantity of fine gravel. By far the greater part of the gravel is limestone,

and the subsoil is generally calcareous. The surface soil has frequently been leached to a considerable extent, and in some places it is slightly acid. The subsoil, however is never in an acid condition.

This soil is subject to considerable variation, especially in the depth of the silty or loess-like covering and the amount of sand or fine gravel present. In the southern part of the county it contains more fine sand than in the northern section. On some of the higher elevations the silt loam covering is absent and the silty clay subsoil exposed over small tracts, while on the lower slopes, in the same locality the surface soil may be considerably deeper than the average. In the southern part of the county a reddish-yellow clay loam subsoil is encountered at about 2 feet in a few places, but such areas are of small extent. A few gravel knolls too small to indicate on the map have been included with this type. There is some variation in the color of the soil, especially where it borders Carrington or Clyde silt loam. In such localities the surface soil has a dark-brown color and the content of organic matter is higher than usual.

*Topography and drainage.*—The surface features of the typical Miami silt loam range from gently rolling to rolling, with occasional areas where the surface is only undulating. In the eastern part of the county, especially in Medina Township, there are a number of rounded hills and ridges upon which the type occurs. There are but few slopes too steep to be cultivated, and modern farm machinery can be used on practically all the type. In the southern part of the county, especially in Rutland Township, the slopes of some of the hills have but a shallow covering of soil, and rock outcrops are numerous.

On account of the surface features of this type the natural drainage is good. It is excessive in a few places where there is more gravel than usual in the soil or occurring in beds beneath the type. The steeper slopes are subject to erosion. But little of the type, however, has been seriously damaged by erosion.

*Origin.*—Miami silt is derived from the weathering of the glacial till and the loess-like material which is encountered throughout most of its area. The loess-like covering is much thinner over the typical soil than over the deep phase, and the glacial till thus enters into the main type to a greater extent than is the case with the deep phase. The underlying rock is

chiefly limestone, and it gives rise to the limestone gravel in the soil section. A large part of the soil material has doubtless been derived from the underlying limestone. In the southern part of the county there are a number of small areas where the St. Peters sandstone occurs, and it is quite probable that the presence of this rock accounts for the more sandy nature of the Miami silt loam in the southern part of the area. The calcareous nature of the subsoil is due to the influence of the limestone.

*Native vegetation.*—The original forest growth on Miami silt loam consisted chiefly of white, black, and red oak and maple, with some hickory, basswood, and elm. Over a part of the type the timber growth was scattered, and the term "oak openings" is frequently used to describe this condition. The typical soil was more heavily forested than the deep phase.

*Present agricultural development.*—It is estimated that approximately 80 per cent of the typical Miami silt loam is under cultivation, while the remainder is chiefly devoted to permanent pasture. The chief type of agriculture followed consists of general farming and dairying. Farming operations are confined chiefly to growing corn, small grains, and hay. Corn averages about 35 busehls, oats about 35 bushels, barley 25 bushels, wheat 10 to 30 bushels, and timothy and clover hay mixed 1 ton to 1½ tons per acre. In the southeastern part of the county tobacco is grown as a special crop, chiefly in the vicinity of Stoughton, Oregon, and Utica. Yields range from 1,100 to 1,700 pounds per acre. Where this crop is grown it is given much more care and is fertilized much more heavily than other crops. Dairying is carried on more extensively in the vicinity of Verona than elsewhere on this type.

The value of land on the Miami silt loam ranges from about $75 to $150 per acre.

### MIAMI SILT LOAM, DEEP PHASE.

*Extent and distribution.*—Miami silt loam, deep phase, is an important soil in Dane County. Its most extensive development is in the northeastern section, in Sun Prairie and York Townships.

*Description.*—The surface soil of Miami silt loam, deep phase, to an average depth of 12 to 14 inches consists of a light-brown

silt loam, with a low content of organic matter, but high in silt. The color of the soil varies somewhat with the moisture content, the surface presenting a grey or ashen appearance when dry. With a few exceptions, the surface is practically free from gravel and stones, and but few areas contain as large quantities of fine sand as occur in the typical soil.

The subsoil consists of a yellowish-brown silt loam, which gradually becomes heavier with depth. At about 24 inches it is usually a silty clay loam which extends to a depth of 3 to 6 feet, where is encountered a mixture of sand, silt, clay and gravel. This sandy gravelly portion of the lower subsoil is undoubtedly the true glacial till, while the extremely silty material above it resembles loess. The upper subsoil sometimes contains thin layers of fine and very fine sand, while the lower subsoil may be slightly mottled with brownish red, yellow or drab. There is usually an abrupt change from the silty or loess-like portion of the subsoil to the true glacial till, the stones, boulders, or gravel being almost or entirely lacking in the upper part, but rather numerous below. The gravel consists chiefly of limestone.

While the deep phase as a whole is very uniform, a few local variations occur. Where this soil borders the Carrington or Clyde soils the color at the surface is darker than the average. Where it borders the typical Miami silt loam or Miami fine sandy loam the subsoil is frequently somewhat sandy below a depth of 24 inches. In a few places knolls or small hills occur within the type over which the silty covering is shallow and where the subsoil consists chiefly of a mixture of sand, clay and gravel. Such areas, where of sufficient extent, are included with the typical soil.

Miami silt loam, deep phase, resembles Knox silt loam quite closely in color and texture, and has a similar extremely silty or loess-like nature. It is underlain, however, by sand and gravel—the glacial till—, while the Knox silt loam is underlain by decomposing limestone. The phase also resembles the Carrington silt loam in texture and origin, but it is light colored and was originally timbered, while the Carrington is dark-colored and is a prairie soil.

*Topography and drainage.*—The surface of this phase is generally less rolling than that of the main type. The topography varies from gently undulating to gently rolling, the slopes being long and gentle. There are some small areas where the surface

is nearly level, and in which, even where the surface has a gentle slope, tile drains are sometimes needed. Over most of the phase, however, the natural surface drainage is good. The soil is somewhat more compact than in the main type, and the downward movement of water is not so rapid as in the lighter textured soils. The soil retains moisture very well, and crops suffer less during long dry periods than on most of the other soils of the county. The phase is not subject to destructive erosion.

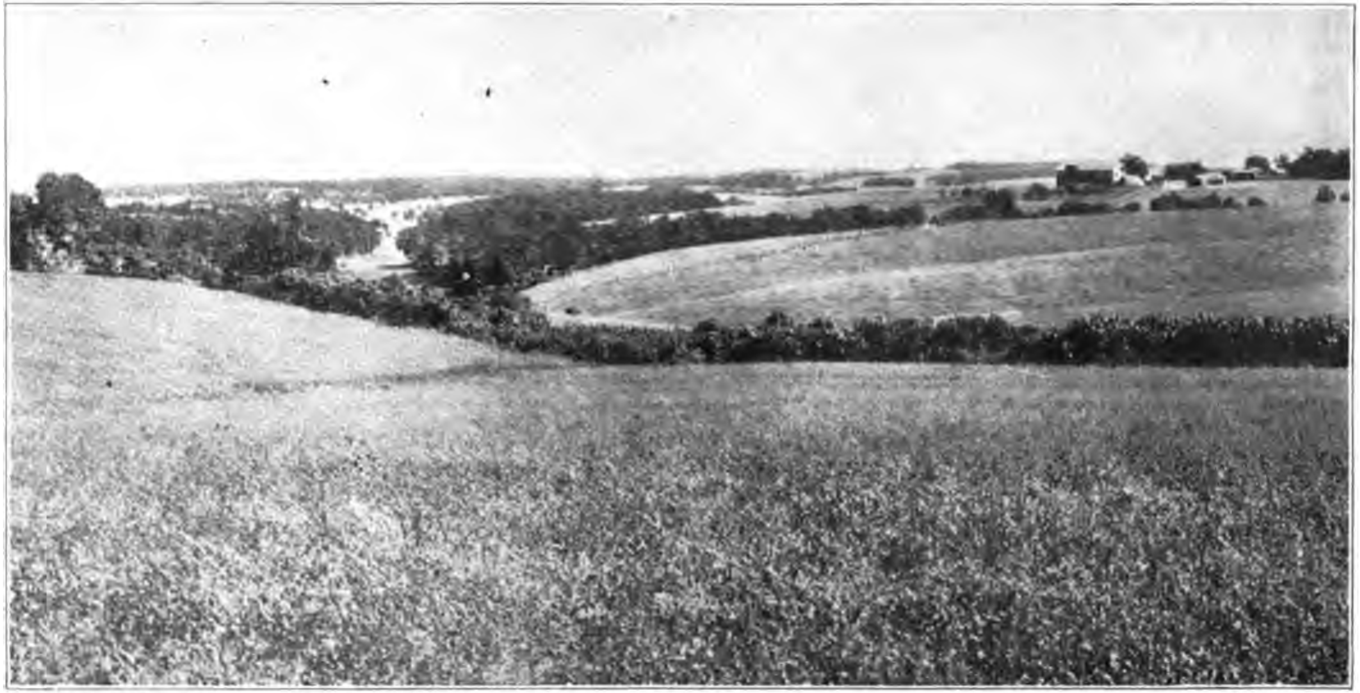
*Origin.*—The deep phase of Miami silt loam owes its origin to the weathering of the loess-like covering over the glacial till. The loess-like material occurs as a mantle over all of this phase. It may have been blown on the glacial ice sheet which covered this region, gradually settling as the ice melted as a covering over the glacial debris. The underlying subsoil consists of typical glacial till. It contains large quantities of limestone gravel and is highly calcareous, while the surface silty material contains but little calcium carbonate, and is frequently in an acid condition. The phase is made up more largely of silty loessial material than the typical soil. The underlying rock, from which much of the glacial till is derived, is limestone.

*Native vegetation.*—The original forest growth on the phase was not as dense as on the typical soil and much of this land was referred to as "oak openings." Timber consisted of white, red, and black oak, hickory, maple, basswood, and some elm. Practically all of the merchantable timber has been removed, and about all that is now left is in small tracts of 1 to 10 acres of second-growth trees, suitable chiefly for fuel.

*Present agricultural development.*—There is only a very small part of the deep phase not cultivated. It constitutes good agricultural land, and many highly improved farms are located upon it. General farming is the chief type of agriculture followed. Dairying is carried on to some extent, and special crops are grown in some sections. For quality of products this phase is unexcelled in the county and only the Carrington silt loam, the Clyde soils, and the Waukesha soils produce heavier yields of certain crops. Corn yields about 40 bushels per acre on the average, oats about the same. Barley averages 30 bushels, and wheat produces 10 to 30 bushels per acre. For a number of years wheat was not grown, the farmers claiming that it could no longer be produced profitably. During the last few years,

TYPICAL VIEW ON MIAMI SILT LOAM

This is the most extensive and important type of soil in Dane County. It occupies an acre of over one quarter million acres or 32.9 per cent of the entire county.



VIEW OF KNOX SILT LOAM, SHOWING TYPICAL SURFACE FEATURES.

This is the most extensive type of soil in southwestern Wisconsin. In Dane county there are 94,976 acres.

however, some very successful crops have been grown. Clover and timothy, mixed, yield 1½ to 2½ tons per acre.

A number of the farmers are engaged in growing peas. Peas for canning yield about 2,000 pounds per acre, and dry peas about 20 bushels per acre, although larger yields are frequently reported. Where the green peas are used for canning, the vines make good ensilage, and may be utilized profitably for feeding cattle. The leading varieties of peas are the Alaska, a very early pea, and the Horsford and Advance, which mature somewhat later. Sugar beets are grown in Sun Prairie and Bristol Townships, with yields of 10 to 17 tons per acre. The sugar content is higher than that of beets grown on the dark-colored soils. Between Sun Prairie and Waunakee, and to a smaller extent in the vicinity of Marshall, tobacco is grown as a special crop. Considerable tobacco is also grown on this phase in the vicinity of Albion, though this soil is more limited in extent in the southern and southeastern sections of the county than in the northern and northeastern. Yields of tobacco range from 1,000 to 1,800 pounds per acre.

In general the same methods of farming are followed on the deep phase as on the typical soil. While the texture is somewhat heavier than that of the typical soil, it is as easily cultivated, as there are no steep slopes. The drainage is not as thorough, however, and in the nearly level areas it is a little later than the main type. The rotations followed, methods of fertilization, etc., are the same as for the typical soil, and the same methods of improvement are needed. The dairy industry offers good opportunities on this phase, and in general it is suited to a more intensive system of farming. Tiling is advantageous where the land is nearly level, and backward in the spring. Where tobacco is grown the remainder of the farm is frequently neglected. The tendency at present seems to be to reduce the tobacco acreage, and to give increased attention to the dairy industry. Alfalfa is coming to be an important crop.

The value of land of this character ranges from $100 to $150 an acre. In regions where tobacco is grown extensively the price for small tracts of land is still higher.

## CHEMICAL COMPOSITION AND MANAGEMENT OF MIAMI SILT LOAM AND MIAMI SILT LOAM, DEEP PHASE.

As stated in the paragraph on origin, this soil was formed largely by the grinding up of underlying rocks by the ice during the glacial period and mixing this ground limestone with soil and clay of residual soils brought from farther north. In consequence it is not generally acid, but the leaching action of water dissolving out this lime corbonate from the surface soil has removed it and permitted the development of acidity over a part of the area. This is true especially of the hilltops and it is probable that the surface soil from a quarter to a third of the area of this type is acid and should be limed to suit it thoroughly for the growth of alfalfa. The degree of acidity so far developed does not yet appear to interfere with the growth of clover in many cases.

The chemical analysis of this soil shows it to contain on the average between 1100 and 1200 pounds of phosphorus in the surface eight inches, approximately 3000 pounds of nitrogen, and between 30,000 and 40,000 pounds of potassium. This amount of phosphorus is relatively high and it is comparatively easy to retain the phosphorus supply necessary to feed staple crops on this soil. When most of the crops grown on the farm are fed, the manure carefully preserved and returned to the land, and especially if some feed is purchased which contains phosphorus, comparatively little fertilizers need be purchased to maintain the supply of this element, but unless some bran or other feeds containing phosphorus are purchased, some phosphorus fertilizers will in time be needed, even on the dairy or stock farm, and when special crops, such as sugar beets, tobacco, etc., or grain for sale are raised, this element must be supplied, and the heavier the yield the more important does this matter become.

The nitrogen and organic matter in this soil on an average are naturally relatively low and all lines of farming should include the growing of clover, alfalfa or other legumes either for feed or for green manure in order to maintain and increase it. This is a much better method of securing nitrogen as a rule than the use of commercial fertilizers containing that element, though in special cases commercial nitrogen fertilizers can be used to advantage. The use of clover or other legumes in rotation, even with special truck crops, not only adds nitrogen but also adds

organic matter which improves the tilth and assists in keeping ground free from weeds. On an average not less than a quarter of the land should be in legume crops annually.

The amount of potash in this class of soil, as in fact in practically all clay loam or silt loam soils, is very large, but the amount supplied to the growing plants depends on the rate at which it is changed from the inert form to soluble and available form. The presence of a good supply of actively decomposing vegetable matter, such as stable manure or a green manuring crop, is the most important condition affecting this change. When this condition exists there will in practically all cases be a sufficient supply of available potassium for nearly all crops, but such special crops as tobacco, cabbage, and in some cases even potatoes, will be assisted by an additional application of potash salts.

The natural drainage of nearly all of this type is good. There are, however, some tracts where the levelness of the surface or the drainage of higher land to it, will require the use of tile to get thorough drainage.

The surface of this soil for the most part is undulating but is seldom so rough as to cause serious erosion. Nevertheless there are a great many fields of this type of soil in the county on which erosion produces a great deal of damage. Farmers owning lands of this kind should give these fields closest attention to prevent this injury. Methods of lessening erosion are discussed more fully on page 28 in the description of the Knox silt loam, which is much more subject to erosion than Miami soils as a rule.

The intermediate character of this soil together with the good supply of lime adapts it to a wide range of crops. It is especially adapted to grass both for hay and pasture, to clover and alfalfa, and to the small grains, but corn also grows very well when the proper attention in regard to organic matter and phosphorus is observed, and when well fertilized sugar beets and other special and truck crops succeed very well.

### MIAMI LOAM.

Miami loam occurs in small areas in various parts of the county in association with Miami silt loam and fine sandy loam. The largest area lies 2 miles southwest of Madison. The surface soil to an average depth of about 10 inches consists of a light-brown loam containing a large quantity of fine sand and silt.

This is underlain by a yellowish brown, heavy sandy loam or sandy clay loam which becomes somewhat heavier with depth. At about 2 feet glacial material consisting of sand, clay, gravel, and bowlders, is encountered. Most of the gravel is limestone. In places this soil is lighter than typical, approaching a fine sandy loam. It appears to be a gradation between the silt loam and the fine sandy loam of the Miami series.

The topography is usually gently rolling, and the natural drainage is good. On some of the steeper slopes there is some danger of erosion, but little damage has resulted from this source.

Miami loam is derived from the weathering of glacial material, most of which was formed from the underlying limestone. The surface has been leached to a considerable extent, however, so that it is frequently found to be in an acid condition, while the subsoil is usually well supplied with lime.

Chemical analyses show that this soil resembles the Miami silt loam very closely in chemical composition, except in the phosphorus content which is usually slightly lower. Much of the type is farmed in conjunction with Miami silt loam, and the crops grown, yields obtained and methods for management are much the same as for that soil.*

### FOX SILT LOAM.

*Extent and distribution.*—Fox silt loam is of moderately large extent and occurs in various parts of the glaciated portions of the county. It is developed along the north shore of Lake Mendota, near Springfield Corners, and in the northwestern and south-central parts of the county. This soil also occurs in small areas southeast of Stoughton.

*Description.*—The surface soil of Fox silt loam, extending to an average depth of 10 inches, consists of a brown loam which contains large quantities of silt and very fine sand. The content of organic matter is somewhat higher than is usual for this soil, the color frequently being almost as dark as that of the Waukesha soils. The subsoil consists of yellowish-brown loam to silt loam, with a small percentage of fine and very fine sand. With increasing depth the content of sand usually becomes greater. All of this soil is underlain by stratified sand and gravel. In a few places the gravel lies within 2 feet of the

*See page 18 for discussion of the management of Miami silt loam.

surface. Even though there is considerable limestone in the gravel, the surface soil, as indicated by tests with litmus paper, is strongly acid in many instances.

*Topography and drainage.*—The surface of Fox silt loam is level to very gently undulating and the natural drainage is fair, except where the gravel and sand layer lies at considerable depth in which case the drainage is frequently poor. Such areas are so situated, however, that they could be readily tile-drained.

*Origin.*—Fox silt loam occurs as outwash plains or old valley fill, and was all deposited by water, chiefly by streams issuing from the glacial ice sheet. The parent material is glacial debris which was mainly ground from the underlying limestone of the region. While the soil has been considerably leached since its first deposition, it usually contains some carbonate of lime, which tends to prevent the development of an acid condition. The original forest growth consisted chiefly of elm, ash, hickory, and oak.

*Present agricultural development.*—The greater part of this soil is under cultivation, and general farming is the chief type of agriculture. Where the drainage conditions are best, yields average about the same as on Miami silt loam, with which this soil is often associated. Corn, oats, barley, clover, and timothy are the general farm crops grown, and as this soil occurs in small tracts, it usually only forms parts of fields where Miami silt loam is the predominating type.

The value of farms on this soil ranges from $60 to $150 an acre, depending upon the condition of the land, improvements, location, etc.

*Chemical Composition and Management.*—This soil is one naturally having a high degree of fertility. The chemical analysis shows it to have on the average between 2500 and 3000 pounds of nitrogen, 1000 or 1200 pounds of phosphorus, and about 35,000 pounds of potassium per acre to a depth of eight inches. The organic matter and nitrogen are somewhat low and methods of increasing this element should be kept distinctly in mind by farmers working on this soil. When most of the crops grown are fed and the manure returned the nitrogen and organic matter may ordinarily be kept up, provided at least a quarter of the farm is in clover, alfalfa or other legumes regularly, and no considerable amounts of grain are sown. Level land of this kind, free from stone and having good fertility is of course ex-

ceptionally well adapted to special crops, such as tobacco, sugar beets, peas for canning purposes, etc. When such crops are grown fertility must be maintained at a high state to make their production profitable. Lime should be used for correcting acidity, and legumes should be grown either for feed or as green manure for maintaining the nitrogen supply. Some form of phosphate fertilizer should be used for maintaining or increasing the supply of this element. Some small fields of this soil need better drainage for which tile is by all means the best method. The soil on the whole has good under-drainage as the result of the fine gravel and sand found in the subsoil.

## FOX LOAM.

Fox loam is an inextensive soil in this county, the largest area, comprising slightly more than a square mile, occurs in the south-central part of the county, immediately northwest of Brooklyn. There is a smaller area southeast of Sauk City, in the north-western corner of the county.

The surface soil of Fox loam, extending to an average depth of 10 inches, consists of a brown loam which contains large quantities of silt and very fine sand. The organic matter content is somewhat higher than usual for this type, and the color frequently approaches that of the Waukesha soils. The subsoils consist of yellowish-brown loam to silt loam, with a small percentage of fine and very fine sand. The content of sand usually increases with depth, and in all cases this soil is underlain by stratified beds of sand and gravel. In few places the gravel lies within 2 feet of the surface. Even though there is considerable limestone in the gravel, the surface soil, as indicated by the litmus-paper test is strongly acid in many instances.

The surface of this soil is level or gently undulating, and the natural drainage is good. It occurs as a terrace formation and is of alluvial origin. It is well above the present flood plain.

This soil is now highly improved. In the area near Brooklyn corn yields 35 to 45 bushels, oats 30 to 45 bushels, barley 30 to 40 bushels, and hay 1½ to 2 tons per acre. Other portions of the type are of nearly equal value for crop production. The rotation usually followed consists of corn, followed by small grain for two years, and then timothy and clover. The soil is easy to cultivate and a mellow seed bed can be obtained without difficulty.

Land with Fox loam soil near Brooklyn is valued at $125 to $135 an acre. Elsewhere it has a somewhat lower value.

In chemical composition this soil resembles Fox silt loam, although it is slightly lower in phosphorus. The same methods for the improvement of that soil are applicable for Fox loam.*

KNOX SILT LOAM.

*Extent and distribution.*—Knox silt loam is confined chiefly to the western and southwestern portion of Dane County. Throughout that region this soil, with its steep phase, is the predominating type. The typical soil occupies the tops of ridges and gentle slopes, while the steep phase is found along the steep hillsides and narrow ridge tops. Associated with this soil are numerous areas of Rough stony land, where the surface is very steep and where rock outcrops are common on the valley walls.

*Description.*—The surface soil of Knox silt loam has an average depth of 12 inches and consists of a light-brown or greyish brown silt loam, with a very smooth feel and containing only comparatively small quantities of organic matter. This soil in its extremely silty nature resembles loess. The subsoil consists of a yellowish-brown heavy silt loam, which gradually becomes heavier in texture with depth, until at 18 inches there is a silty clay loam.

Below this depth the subsoil continues a silty clay loam or clay loam to more than 3 feet. Both surface soil and subsoil of the Knox silt loam are free from coarse sand, gravel, or stones, and the texture as a whole is very uniform. Tests with litmus paper indicate that there is in places a slight acid condition.

The variations which occur in the Knox silt loam are in depth of the soil and in topography, rather than in texture. The greatest variation is in topography and a steep phase of this type has been mapped separately. Another variation which is not indicated on the map is in depth to the underlying rock or to the decomposed rock—the residual material—derived from the underlying rock. Usually the silty or loess-like covering has a thickness of 6 to 10 feet, but there are places where the underlying residual material is within 3 feet, and occasionally over small areas within 1 foot of the surface. The underlying rock

*See page 21 for chemical composition and management of Fox loam.

is usually limestone, which on decomposing has formed a yellowish-red or red clay loam or clay. Immediately over the rock the clay may have a variegated color, red, brown, yellow and drab being common. Where the rock is near the surface limestone fragments and some chert occur in the subsoil and in places on the surface. Where sandstone is the underlying rock, as is sometimes the case, the deep subsoil is sandy, and sand is more or less mixed with the silt. In such cases, as bedrock is approached the fine sand becomes more abundant. Such areas are comparatively inextensive. In this portion of the county the limestone in places is rather sandy, also in the sandstone there are occasionally thin clay or shale layers, from which in either case a sandy or gritty clay loam or clay could be formed by the decomposition or weathering of the rock.

Included with this soil are some areas of light-colored silt loam south of Verona where there is some indication that the country has been glaciated—occasional rounded boulders which are not of sandstone or limestone, but where the silty loess-like soil covers the whole country, and, with the exception of a few scattered bowlders, the soil resembles the typical Knox silt loam.

A variation in color of the Knox silt loam occurs where the type borders Dodgeville silt loam, which is dark brown or black in color. In such places the surface soil has a darker color than the average, and the subsoil also is sometimes darker than usual, while the lower portion of the subsoil is the same as in the case of the typical soil.

The texture and color of Knox silt loam are very similar to those of the deep phase of Miami silt loam. There is also a similarity in texture to that of Dodgeville silt loam and Carrington silt loam, but both of these are dark in color and are prairie soils while Knox silt loam is light in color and is forested.

*Topography and drainage.*—The topography of the typical soil varies from undulating to gently rolling, but the surface is not so steep as to prevent the efficient use of farm machinery. Where the slope is too steep for cultivation with modern farm machinery, it is mapped with the steep phase. The more nearly level areas are confined to the broad ridge tops. Where the ridges are narrow the surface is more broken, and the slopes grade into the steep phase. The natural surface drainage is good. Only on the nearly level ridge tops, which are of comparatively small extent, would tile drains be found profitable.

The subsoil is heavy and compact, and the movement of water through the soil is not as free as where there is some sand and gravel mixed with the subsoil, as is usually the case in the Miami soils. Where the bedrock is near the surface the soil may be somewhat droughty. This soil erodes readily, and when slopes are left bare ditches and ravines are formed rapidly.

*Origin.*—Knox silt loam is probably derived from the weathering of the silty or loessial mantle which seems to cover this section of the county, and from the decomposition of limestone which underlies the present soil at depth of three feet or more. Those areas south of Verona which have been lightly glaciated are of the Pre-Wisconsin drift sheet. Only scattered evidences of glaciation, such as crystalline bowlders, and some rounded gravel are to be found in this region. The silty loessial covering apparently extends over the old drift with the resulting soil very similar in origin to the typical Knox silt loam.

*Native vegetation.*—The original forest growth consisted of white, bur, and black oaks, with some maple, poplar, hickory, birch, and basswood. All of the type was originally forested, but the timber remaining is largely confined to the steep phase, with a few woodlots on the main type.

*Present agricultural development.*—By far the greater part of the typical soil is under cultivation, although some of the steeper slopes are kept in permanent pastures or woodlots. The type of agriculture followed most extensively consists of general farming in conjunction with dairying. That this is proving very profitable is shown by the number of silos and new barns which are being constructed and the many large comfortable farm houses which are common on this soil.

Of the crops grown corn produces about 40 bushels, oats 35 bushels, wheat 15 bushels, and timothy and clover mixed about 1¼ tons of hay per acre. Alfalfa is being tried on a small scale by many farmers and is proving to be a very valuable crop. Some tobacco is grown, but the acreage, which is small at present is becoming less each year. On many farms there is a limited amount of land desirable for corn because of the danger of serious washing on even rather gently rolling slopes when in an intertilled crop. This coupled with the large amount of permanent pasture on all these farms has been one factor in determining the type of agriculture of this portion of the county. Dairying has become the most important industry on this soil.

The result of small acreage of corn has been to keep the hog raising industry as a minor part of the farm business. On this account it has not been as profitable to use the milk for butter where there would be a considerable amount of skimmed milk, so desirable for feeding hogs, as to use it for cheese. The result has been that a very extensive cheese making industry has been developed in the section of the county where this soil predominates.

Although no systematic rotation of crops has generally been adapted for this soil, an increased number of farmers are giving this matter careful attention. Where practically all of the farm is ridge land the rotation commonly followed consists of corn one year, followed by a small grain crop for one or two years. The small grain is usually oats or barley, although some wheat is still grown. With the last grain crop clover and timothy are seeded, and hay is usually cut for two years before the land is again plowed for corn. Because of the amount of steep land in permanent pastures associated with this soil, the cultivated portion of the farm is usually not pastured. By far the majority of the farmers of this region live in the valleys and both ridge and valley lands are included in the farms. In such cases much of the corn is grown in the valleys, on the lower slopes below rough stony land or the steep phase of the Knox silt loam and on the higher portions of the valley lands. The rotation common for the Knox silt loam ridge land in such cases, especially where the land has a slope that would make it apt to wash badly when in an intertilled crop, consists of grain two years, then seeded to timothy and clover for hay. Timothy or clover sometimes is cut for seed. After being seeded down for two or three years the land is put in grain again. Very often these ridge lands do not receive much manure because of the difficulty of the haul from the valley, with the result that some fields show decreasing yields.

The value of farms on this soil varies widely depending on location, improvements and on the topography of the land, the more broken areas being as low as $30 to $50 per acre, while the gently rolling portions are held at $80 to $100 or over per acre.

*Knox silt loam, steep phase.*—Knox silt loam, steep phase, is confined to the southwestern part of the county, and is closely associated with the typical Knox silt loam. It forms a part of

nearly all the farms containing the latter and has considerable influence in determining the type of agriculture followed.

The soil usually resembles that of the main type, but is subject to more variation and forms a thinner covering over the underlying rock. The surface soil is usually a light-brown silt loam to a depth of about 10 inches. This is underlain by a yellowish-brown silty clay loam which usually extends to a depth of 3 feet or more. In many places erosion has removed the surface covering and heavy silty clay loam forms the surface soil. In other places, especially where the soil is shallow, rock fragments are mixed with the soil. Over sandstone there is frequently considerable fine sand incorporated with the soil, and the deep subsoil may consist of a fine sand or fine sandy loam. Where limestone is the underlying rock the subsoil is frequently a red or reddish-brown, heavy clay loam containing cherty fragments. Rock outcrops occur in a few places on this phase.

This soil has a rolling to hilly surface, and comprises steep slopes and sharp, narrow ridges over which the grade is sufficient to prevent or greatly interfere with the use of modern farm machinery, and where the danger from erosion is so great that intertilled crops can seldom be grown with safety.

The steep phase has the same derivation as the typical soil, but usually the underlying rock is nearer the surface. The original forest growth consisted of several varieties of oak, maple, hickory, birch, and basswood.

Only a small part of the steep phase is under cultivation. Most of it is still forested, and where the timber has been partially or completely removed the land is generally in permanent pasture. The timbered areas are best kept forested.

As a whole the soil of the steep phase is somewhat less productive than the main type, but if the surface were less broken it would be considered a fair agricultural soil. Associated with the steep phase are areas of Rough stony land, and these, together with the steep slopes, tend to reduce the value of tracts of typical Knox silt loam with which they are associated. This phase may be profitably used on all dairy farms as grazing land.

*Chemical Composition and Management.*—The analysis of this type of soil shows it to contain on the average from 900 to 1000

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*See Bulletin No. 272 of the Wisconsin Experiment Station on "Keep Hillsides from Washing" for suggestions for controlling erosion.

pounds of phosphorus, about 2700 pounds of nitrogen, and 35,000 pounds of potassium per acre to the depth of eight inches. Acidity is quite general in the surface soil of the hilltops and upper slopes of the hills, but the acidity which would naturally develop on the lower slopes is often neutralized by lime brought down by the seepage of water over the limestone underlying the surface soil of these hills. The growth of clover and alfalfa which is extremely important as a means of increasing the nitrogen and organic matter of this soil therefore requires the use of lime in some form quite generally.

As indicated by the chemical analysis the total content of phosphorus in this soil is not high and the proper use of phosphorus fertilizers supplementing the natural supply along with the growth of clover or other legume for increasing the organic matter will be found to be the best means of increasing the fertility of this type of soil.

*Erosion.*—The roughness of the land occupied by this type of soil leads to a large amount of erosion or side hill wash. This erosion develops gulleys which interfere seriously or even prevent the working of the fields and removes a great deal of fertility by taking off the finest part of the soil including the organic matter. It is of the utmost importance therefore that owners of land of this type prevent erosion just as far as possible. The best means of lessening erosion consist in keeping the side hills in grass for hay or pasture as much as possible, and at any rate, of raising but one crop of corn or other tilled crop in each period of rotation. If a rotation for the side hills consisting of corn one year, which is sown to rye at the last cultivation, and then seeded to clover with timothy one or two years following the grain, and then used as pasture for two or three years before being again broken, the erosion is greatly reduced. Corn can be grown in this way one year on the sod with much less erosion than would result the following year if it were again planted to this crop.

The fields on side hills should be laid out as long narrow fields along the slope and so arranged that the dead furrows of the lands, which should be very narrow, can be opened into side ditches which are kept grassed.

Many farms in this section include some land in the valley which suffers but little from erosion, as well as a good deal on the side hills. In such cases two systems of crop rotation

should be followed. One as suggested on the steeper land, and another on the low land in which the land is laid out in two fields to be cropped alternately to corn and alfalfa for three or four years. A large part of the manure on the farm may be applied to the corn for all excepting the last year it is grown in rotation. This should be supplemented with some form of phosphorus, probably raw rock phosphate being best for that use, thoroughly incorporating it with the manure. If in addition to this the land is kept free from acidity maximum crops of corn and alfalfa may be grown on the more level land. Then by keeping the side hills free from acidity by use of lime or ground limestone and moderate applications of soluble phosphate fertilizer and growing of clover or other legume in the rotation, the fertility of the side hills can be maintained with relatively little manure. But light dressings of well rotted manure will be found very helpful in improving pasture on this land. It must be remembered that continual pasturing of land alone does not maintain the fertility but leads toward its depletion, and it is only by giving the pasture some attention as above suggested that the great profits which may come from first class pasturage can be expected.

### BOONE LOAM.

Boone loam is confined to the southwestern section of the county and it is closely associated with Knox silt loam and Boone fine sandy loam. Its extent is small, and the individual areas are comparatively unimportant.

The surface soil of Boone loam has an average depth of about 10 inches, and consists of a light-brown or grayish silt loam, which contains only a comparatively small amount of organic matter It is underlain by a lighter colored loam or fine sandy loam, which gradually becomes heavier with depth and grades into a sandy clay at about 2 feet. This heavy subsoil extends to a depth of 3 feet or more where the rock occurs at considerable depth, or it may grade into a fine sandy loam or fine sand where the rock is within 3 feet of the surface, as is sometimes the case. Immediately over the rock the subsoil frequently has a mottled reddish color. The type as a whole is quite variable, but averages a loam in texture. An acid condition in the surface soil is quite general.

The surface of the type is rolling, and there is some danger

of erosion on the steepest slopes. The natural drainage is good, and excessive where the rock is near the surface.

This soil is of residual origin. It is derived largely from the underlying rock formations, which are limestone and sandstone. It is probable that a small part has been derived from the loessil material entering into the composition of Knox silt loam. The sandstone has contributed largely to its formation.

The natural timber growth consisted of several varities of oak, hickory, basswood, birch, and some poplar. The merchantable timber has been removed, but a large part of the type is still uncleared.

About one-third of this type is under cultivation, and it is largely devoted to general farming, like the Knox silt loam, with which it is associated. The steep land is used only for pasturage. Corn yields average about 30 bushels, oats 32 bushels, barley 30 bushels, and hay about 1 ton per acre. The methods of cultivation, crop rotation, and fertilization followed are practically the same as on the Knox silt loam,* and this soil responds to the same treatment.

*See page 27 for Chemical composition and management of Knox silt loam.

# CHAPTER III.

## GROUP OF HEAVY, DARK COLORED UPLAND SOILS.

### CARRINGTON SILT LOAM.

*Extent and distribution.*—Carrington silt loam with its shallow phase is one of the most important and highly prized soils in the State. In Dane county the largest area occurs in the northern part of the county, in Bristol, Windsor, Vienna, Dane, Burke, and Springfield Townships. Extensive tracts lay north, northeast, and northwest of Madison. This type is also encountered in the southeastern part of the county in Dunkirk, Albion, and Christiana Townships. A few smaller areas are found in various parts of the central and eastern portion of the county. Carrington silt loam is closely associated with its shallow phase, and grades into it so gradually that a boundary between the type and the phase is often difficult to establish and is always more or less arbitrary.

*Description.*—The soil of Carrington silt loam to an average depth of about 12 or 14 inches, consists of a dark-brown to almost black silt loam, having a smooth feel and containing large quantities of organic matter. Litmus tests indicate that the surface soil is in an acid condition. The subsoil consists of a dingy-brown silt loam in the upper part, becoming lighter in color and heavier in texture with depth, until at 22 to 26 inches there is a yellowish-brown, compact silty clay loam, in which the silt content is very high. This heavy subsoil usually extends to a depth greater than three feet, and ranges from 2 to 8 feet in thickness. The entire soil section is practically free from gravel stones, and bowlders, and is remarkably uniform in structure and texture. Immediately below this silty or loess-like mantle the typical glacial till, consisting of clay, silt, sand, and gravel, is encountered. The line of demarcation between

the yellow or yellowish-brown silty clay loam and the glacial till is well defined, the upper part being free from bowlders and gravel and leached free of calcium carbonate, while the till is filled with stones and bowlders and is well supplied with calcium carbonate.

A number of variations occur in Carrington silt loam, but only the shallow phase, described later, is of sufficient extent and importance to be indicated on the soil map. Where this type borders Miami silt loam the color is somewhat lighter and there is less organic matter present. Where it borders Miami fine sandy loam or Carrington fine sandy loam there is usually more fine sand in the surface soil and the subsoil than is typical. Bordering Clyde silt loam a gradation appears in the weathering of the subsoil, passing from the dark or drab subsoil of the Clyde to the dingy brown or yellow of the Carrington. The water table becomes lower, and the soil oxidation is more marked with improved drainage conditions. Over some of the higher elevations of this soil the silty loess-like covering is rather shallow, but the depth to underlying rock ranges from 10 to 50 feet through the type.

Carrington silt loam resembles Miami silt loam and Knox silt loam in texture, but is much darker in color, while it is about the same color as the Dodgeville silt loam.

*Topography and drainage.*—The surface of this type varies from level to undulating and in some places gently rolling. The slopes are long and gentle, and there is seldom any damage from erosion. In most places the surface has a sufficient slope to provide good natural drainage, but in the level areas the drainage is somewhat deficient and tiling is needed.

*Origin.*—Carrington silt loam is derived from the weathering of the loess-like covering over-lying the glacial till. The extreme silty material has a depth of 2 to 8 feet, and between this and the underlying typical glacial till there is a sharp line of demarcation. The gravel, stones, and bowlders in the drift are largely of limestone, and, while the soil is in an acid condition, the deep subsoil composed of till is not acid and contains a large amount of carbonate of lime.

*Native vegetation.*—Carrington silt loam is a typical prairie soil, and the native growth consisted almost entirely of prairie grasses, with some oak, maple, and hickory near the boundaries of other types and along streams.

VIEW OF CARRINGTON SILT LOAM, SHOWING SURFACE FEATURES, BUILDINGS, ETC., TYPICAL OF THE BLACK PRAIRIE LANDS OF SOUTHEASTERN WISCONSIN.

This is one of the best types of soil in the state. In Dane County there are 140,032 acres of this class of land.

VIEW SHOWING COMBINATION DAIRY AND TOBACCO FARM.

These two lines of farming are extensively developed in Dane County. Tobacco growing, however, is gradually giving way to the more extensive development of the dairy industry

*Present agricultural development.*—Practically all of this soil is under cultivation. There is only a very small acreage of waste land, the percentage being probably smaller than for any other type in the county. The principal type of agriculture followed on this soil is general farming. In some localities dairying is practiced extensively, and the tendency seems to be toward the more extensive development of this industry. Tobacco is a very important special crop on this soil.

This soil is well adapted to corn, producing an average of 45 bushels per acre. Where the best methods of farming are followed much larger yields are obtained, the production of 60 to 70 bushels being not uncommon. Oats yield 40 to 45 bushels, with considerable higher yields under good management. Some barley is grown, with yields of 35 to 40 bushels. The acreage of wheat is very small. The quality of the small grains is not quite so good as is produced on the light-colored silt loam, such as Miami silt loam. Hay, consisting of timothy and clover, yields 1½ to 2½ tons per acre. Alfalfa is grown to a limited extent. As this soil is usually acid some difficulty is often experienced in getting a good stand, but where properly prepared alfalfa does very well, and the acreage is gradually increasing, especially where dairying is carried on.

Tobacco is the most important special crop grown on this soil and it receives a great deal of attention, especially in the southeastern and northcentral parts of the county. Yields range from 1,200 to 1,600 pounds per acre. Sugar beets yield 12 to 18 tons per acre and are grown quite extensively, especially in the northern part of the county. The sugar content is not quite so high as from beets grown on Miami silt loam, but the yield is greater.

The rotation of crops is given less attention on this soil than on some of the other soils of the county. One reason for this is that tobacco receives so much attention that frequently other crops are somewhat neglected. Tobacco is usually grown on the same field for a number of years, and seldom in rotation. Where alternated with general farm crops the rotation generally followed consists of corn followed by small grains seeded to timothy and clover, and then tobacco two to four years, followed by corn.

Because of the tendency to concentrate interest on the tobacco to the neglect of the remainder of the farm, the general methods

of farming practiced in the tobacco-growing sections are not of so high a standard as in many regions of inferior soils where tobacco is not grown. The yields of the general farm crops are. therefore, hardly a fair indication of what this soil is capable of producing under the best methods of farming.

Carrington silt loam is not a difficult soil to cultivate, and a mellow seed bed can be readily worked up. There is a general need, however, for more thorough cultivation. Stable manure is the only fertilizer used with the general farm crops, and with tobacco it is used to a greater extent than any other form of fertilizer. Twenty to forty loads per acre are often applied to the tobacco field. The supply is not ample, however, and a large part of most farms receives too little stable manure. The practice of plowing under green-manuring crops is not common as it should be.

On account of the level topography, drainage is not always as good as might be desired. Over the extensive level or undulating tracts tile drains are needed. A system of tile drainage would permit the soil to warm up earlier in the spring, so that crops may be planted sooner. Well-drained land works up more readily into a mellow seed bed and permits a more rapid, vigorous growth.

The surface soil of the Carrington silt loam is in an acid condition, and responds to the application of ground limestone at the rate of 1,500 to 2,000 pounds per acre. With such treatment and the inoculation of the soil alfalfa can be grown successfully. This is a very valuable crop particularly where dairying is practiced.

Farms on typical Carrington silt loam range in value from $110 to $175 an acre, depending on location and improvements. In the tobacco-growing sections land in small tracts frequently sells for as much as $200 to $300 per acre.

*Carrington silt loam, shallow phase.*—Carington silt loam, shallow phase, is found most extensively in the southeastern sections, in Cottage Grove, Deerfield, Pleasant Spring, Christiana, Dunkirk, and Albion Townships. Other scattered areas of smaller extent are found in the northern part of the county in Sun Prairie, Burke, Westport, Vienna, Springfield, and Dane Townships.

The surface soil of the shallow phase is similar to that of the typical soil, consisting of a dark brown to black silt loam of

about 12 inches depth. There is frequently present in the surface soil some fine sand and a small quantity of fine gravel. The chief point of variation is in the subsoil. In the shallow phase the covering of extremely silty material over the glacial till is of considerable less depth than in the typical soil. The subsoil consists of a brown or yellowish brown silt loam or silty clay loam containing in places a small quantity of fine sand. Below 20 to 24 inches there is usually a yellow sandy clay which grades into the typical glacial till consisting of a mixture of sand, silt, clay and gravel. The depth to bed rock is usually less than in the case of the typical soil, but this is seldom an important factor, since the covering of soil over rock is sufficient except in a few instances.

The surface of the phase averages a little more rolling than the typical soil, varying from undulating to rolling. It is of the same origin as the typical soil, however, a larger portion is undoubtedly derived from the weathering of glacial till.

Probably over 80 percent of this phase of the Carrington silt loam is under cultivation, and the remainder is chiefly devoted to permanent pasture. The same crops are grown as on the typical soil, but the shallow phase is slightly less desirable for agriculture, and the yields average a little lower. The same conditions as to crop rotations, methods of cultivation and fertilization prevail as on the typical soil, and the suggestions for management of the main type apply to this phase.

*Chemical composition and management.*—A chemical analysis of this tpye of soil shows it to contain on an average about 1600 pounds of phosphorous, between 4800 and 6000 pounds of nitrogen, and aproximately 40,000 pounds of potassium per acre to the depth of eight inches. It is relatively high in organic matter as the dark or nearly black color indicates. This relactively large supply of organic matter is the result of its prairie origin. This supply of organic matter together with the fine texture and large amount of lime in the subsoil gives this type a very high degree of fertility, and wherever the original fertility of the land has been protected by proper management it is still an exceedingly productive soil. In some cases, however, this land has been used largely for the growing of grain and other crops which for the most part have been sowed for so many years that the original fertility has been greatly depleted, although the soil under this condition still retains its dark color,

the organic matter which is left is of a very resistent character and does not decompose readily to furnish the nitrogen or other elements needed by growing crops. The soil under these conditions has also become quite generally acid, probably to a considerable extent on account of the decomposition of the vegetable matter. When this soil is found to be at all low in fertility it must be improved by the addition of phosphorus and active organic matter, preferably through the growth of clover or alfalfa returned to the soil either in stable manure or plowed under as a green manure.

The relatively large amount of organic matter in this soil, its comparatively level surface and high degree of fertility adapt it especially to corn and other crops which require large amounts of plant food. This soil can be retained in an exceptionally high state of fertility more readily than most types of soil.

As a rule this soil has good surface and under drainage but some level areas would be benefited by tile, which would give perfect under drainage.

## WAUKESHA SILT LOAM.

The main occurrences of Waukesha silt loam are in the valley of Black Earth Creek, north of Oregon and east and west of Verona. Other patches are encountered along Koshkonong Creek, about Lake Kegonsa, and in Rutland Township.

The soil of Waukesha silt loam to an average depth of 10 inches consists of a dark-brown to black friable silt loam which contains a high percentage of organic matter. The content of silt is high and the soil has a very smooth feel. The upper subsoil consists of a dark-brown silt loam which contains an appreciable amount of fine sand. At about 16 inches the color is brown. Below this depth the material is a yellowish-brown silt loam to a depth of 4 to 6 feet, where stratified beds of sand and gravel are encountered. The lower part of the subsoil is frequently drab or yellowish in color and contains some fine sand.

The surface of the type is level to very gently undulating, and there is sometimes a very gentle slope toward the stream or body of water along which it is developed. The natural drainage is usually fair, but there are a number of places where it is somewhat deficient.

The most marked variation in this soil occurs between Oak Hall and Oregon, where the underlying beds of sand and gravel are within 2 feet of the surface in a few small areas. The surface soil in such places contains more fine sand than typical, but not enough for the material to be classed as a fine sandy loam.

The main part of this type, in the valley of Black Earth Creek, occurs as an outwash plain. Most of the course of this stream is outside the glaciated region, but the material forming the soil was carried beyond the glacial border by waters rushing from beneath the ice sheet. In other parts of the county this soil occupies outwash plains, lake and stream terraces. The parent material is from the glaciated limestone region, and most of the gravel in the deep subsoil consists of limestone. The surface of the entire type, however, is in an acid condition. After its first deposition the moist conditions which prevailed favored a rank growth of vegetation, and the growth and decay of this accounts for the dark color and high organic-matter content of the soil. Part of this soil was prairie land, and prairie grasses constituted the chief growth. There was some timber, consisting chiefly of oak, some elm, ash, and soft maple, where the drainage was deficient.

Nearly all of Waukesha silt loam is under cultivation and in a high state of productiveness. The greater part of the type is devoted to general farming. Corn yields 40 to 70 bushels, oats 40 to 65 bushels, barley 35 to 45 bushels, and timothy and clover mixed 1½ to 2 tons of hay per acre. In the southeastern section considerable tobacco is grown on this soil and yields of 1,200 to 1,800 pounds per acre are obtained.

The value of land of this type usually ranges from $100 to $200 an acre. Where tobacco is grown, small tracts are held at about $300 per acre.

*Chemical composition and management.*—This soil is one naturally having high fertility. The chemical analysis shows that it averages between 4,000 and 6,000 pounds of nitrogen, 1,200 to 1,400 pounds of phosphorous, and approximately 30,000 pounds of potassium per acre to the depth of eight inches. The presence of the rather large amount of organic matter has lead to the leaching of a large part of the lime from surface soil which has brought about the development of acidity. This condition has its most marked effect on the growth of al-

falfa, clover, peas, and other legumes. For these crops liming will be found very helpful on most of this type, but liming will also be beneficial because of its influence on availability of phosphorus. This element is usually less available in acid than non-acid soils. Land which has been cropped a number of years without the use of stable manure or other fertilizers will be found rather low in available phosporous and the use of some form of fertilizer containing that element will add materially to the fertility.

This soil is well adapted to general farming and is particularly adapted to special crops, such as sugar beets and tobacco. When these crops are grown the use of lime and commercial fertilizers will be highly desirable, since considerable amounts of fertility are removed by these crops.

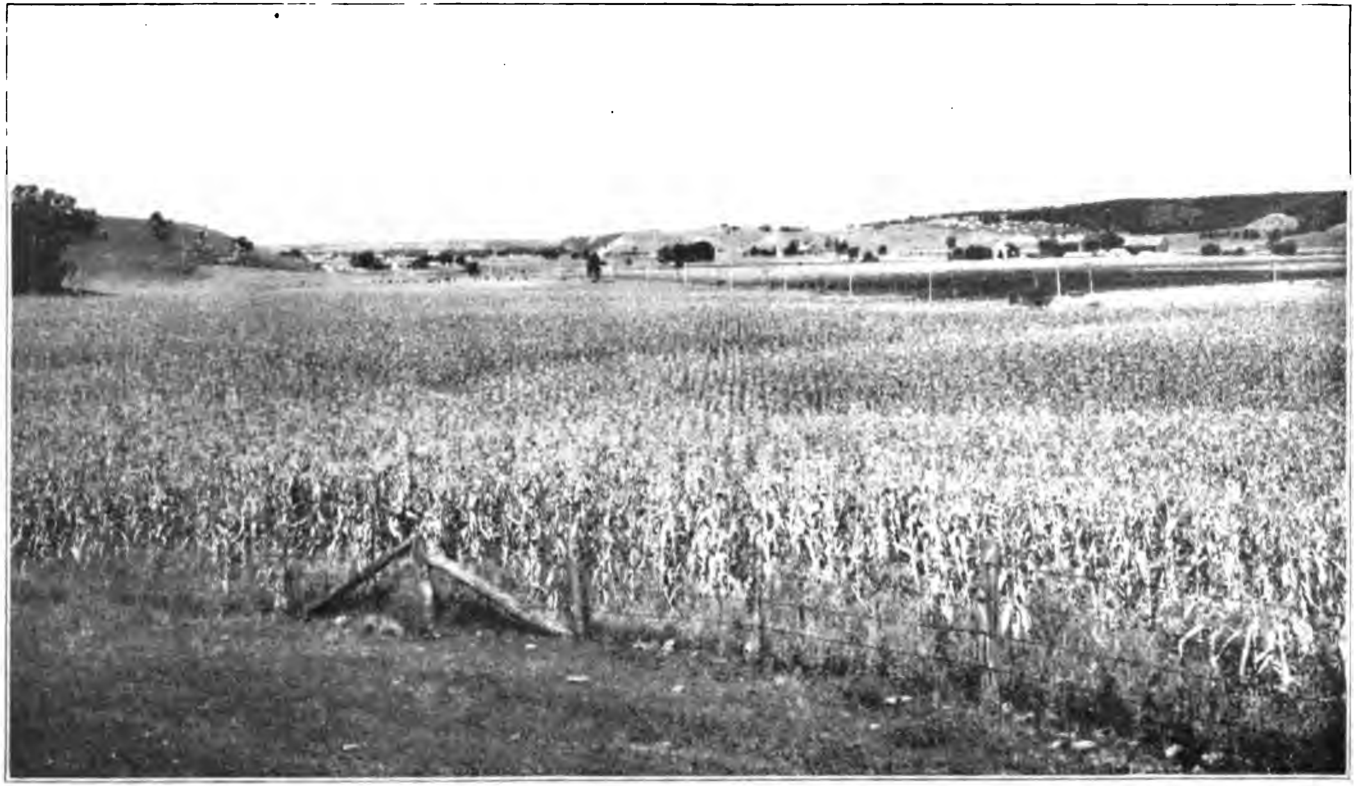
Some fields of this type of soil do not have adequate underdrainage and tiling would be a great improvement on land of this kind.

### DODGEVILLE SILT LOAM.

*Extent and distribution.*—Dodgeville silt loam is confined to the prairie regions in the southwestern part of the county. It has a total area of 51 square miles, and is one of the important soils of the region.

*Description.*—The surface soil of Dodgeville silt loam has an average depth of 12 inches. It consists of a dark brown or black silt loam with a relatively high percentage of organic matter. The soil is free from all coarse particles such as coarse sand, gravel, or stones, and the texture is remarkably uniform. The subsoil consists of a yellowish-brown heavy silt loam which grades into a silty clay loam at about 20 inches. Below this depth the color is a more pronounced yellow. Limestone rock occurs underlying this soil at an average depth of about 4 feet. Outcrops on hillsides are quite common. Where the depth is less than 4 feet, the subsoil frequently has a reddish or yellow-brown color, due to the presence of material derived from the weathering of the limestone. With this part of the subsoil there may be a few rock fragments which have resisted weathering. Litmus-paper tests indicate that the soil is in an acid condition.

*Topography and drainage.*—The surface varies from gently undulating to rolling, though the greater part of the type comprises gently rolling prairie land. The natural drainage is



VIEW SHOWING WAUKESHA SILT LOAM, WITH KNOX SILT LOAM OCCUPYING THE HIGHER LAND IN THE BACKGROUND.

This is a dark colored terrace soil, and is one of the best types of land in the county for the growing of corn.

VIEW SHOWING SURFACE FEATURES OF DODGEVILLE SILT LOAM.

This is typical of the prairie lands of southwestern Wisconsin. It is an excellent general farming soil. There are about 40,000 acres of this kind of land in Dane County.

usually well established, but on some of the more gentle slopes it is probable that tile drains might be installed to advantage. On the steeper slopes there is some damage from erosion, but this can be held in check by exercising care in cultivation and in the selection of crops.

*Origin.*—Dodgeville silt loam is derived mainly from the weathering of the underlying limestone. Possibly the surface material is of loessial origin. On some of the hillsides the surface material has been removed by erosion and the reddish, residual material usually found just above the limestone is exposed. This material is also frequently seen in road cuts. The small part of this type mapped in the south central section of the county where the pre-Wisconsin glacial drift is found may differ slightly in origin from the remainder of the type. The old glacial drift appears to be very thin, and the soil is practically the same as in the driftless area. A few crystalline bowlders occur in this region, and their presence is usually the only indication of glacial action.

*Native vegetation.*—Dodgeville silt loam is a prairie soil, and the native growth consisted chiefly of prairie grasses. There were a few trees on some of the steeper slopes and along the border of other types of soil.

*Present agricultural development.**—Probably 95 per cent of this type is under cultivation, the remainder being in permanent pasture. The type of agriculture most extensively followed consists of general farming and dairying. Corn yields 40 bushels, oats 35 bushels, barley 30 bushels, wheat 15 bushels, and clover and timothy mixed about 1½ to 2 tons of hay per acre. Yields of 1,000 to 1,700 pounds of tobacco per acre are reported, but this crop is not grown as extensively as in former years. The rotation most commonly followed consists of corn, which may be grown two or three years, followed by a small-grain crop possibly for two or three years, after which the land is seeded to timothy and clover and cut for hay for at least two years. Frequently the fields are pastured for a year or more before again being plowed for corn. The tendency is to reduce the length of the rotation by growing corn for only one year, grain for about two years, and hay for only two years. Better results are obtained by such a system.

*For chemical composition and management see page 42.

Dodgeville silt loam is a rather heavy soil, but when cultivated under the most favorable moisture conditions little difficulty is experienced in getting a mellow seed bed. On some of the steeper slopes the heavy subsoil is exposed, and this is more difficult to handle. Barnyard manure is the only fertilizer used, and it is most frequently applied to sod which is to be plowed for corn.

Farms on the Dodgeville silt loam have a value of $75 to $150 or more an acre, depending upon location and improvements.

### DODGEVILLE SILT LOAM, SHALLOW PHASE.

*Extent and distribution.*—This soil is confined to the southwestern part of the county. It has a total area of about 11 square miles. The greater part of the phase being located in a large continuous tract east and southeast of Perry.

*Description.*—The surface soil of the Dodgeville silt loam, shallow phase, is about 10 inches deep. It consists of a dark-brown or almost black silt loam which contains a high percentage of organic matter. Large quantities of fine sand are present in the surface soil, and small fragments of chert are common.

The upper part of the subsoil is a heavy silt loam, considerably lighter in color than the surface soil. At about 16 inches this grades into a reddish-brown clay loam containing numerous chert fragments. With increasing depth this grades into a heavy clay loam or clay, and the chert fragments become more numerous. The usual depth to bedrock varies from 2 to 3 feet, though outcrops along the slopes are quite common. Within a few inches of the underlying rock, which is limestone, the color is variegated, being characteristic of the decomposed rock. Small pockets of sand in the subsoil are common, and in a few small patches the surface material is a fine sandy loam. Such areas usually occur on the slopes, but are too small to be indicated on the soil map. Where large enough to be mapped the fine sandy loam is recognized.

A lighter phase of this type, covering about a square mile, occurs about 2 miles west of Verona. The soil consists of a dark-brown or black loam or heavy fine sandy loam, and the subsoil is a yellowish-brown loam or clay loam, with numerous small patches where the subsoil is a fine sandy loam. While the depth to rock may be 3 feet or more it probably averages about 2 feet, and the phase is more droughty than the typical soil. Both soil

and subsoil are variable, and the value of the lighter phase, as farming land is lower than that of the main type.

*Topography and drainage.*—The topography of Dodgeville silt loam, shallow phase, varies from gently undulating to rolling. The undulating areas occur as ridge tops, while the rolling surface is found where streams have worked back into the type, carving valleys and leaving ridges, along the slopes of which outcrops frequently occur. The natural drainage is well established, and where the soil is most shallow it is somewhat excessive. On the steeper slopes there is some danger of orosion.

*Origin.*—This soil is derived from the weathering of the underlying limestone. The dark color is doubtless due to the decay of a rank growth of grasses under moist conditions.

*Native vegetation.*—Dodgeville silt loam, shallow phase, is a prairie soil, and the original vegetation consisted chiefly of prairie grasses, with only a scattered growth of timber along some of the slopes and bordering forested types.

*Present agricultural development.*—Probably about 65 per cent of this soil is under cultivation, the remainder being used chiefly as permanent pasture. The leading type of agriculture followed consists of dairying in connection with general farming.

Corn yields about 35 bushels, oats 32 bushels, barley about 30 bushels, and hay 1 to 1½ tons per acre. A small acreage of wheat is grown and fair yields are obtained. Yields on the soil of the lighter phase west of Verona are lower than these. Alfalfa is not grown to any extent, but a few farmers are making an effort to get this legume started. The most common rotation followed consists of corn, followed by small grain, with which clover and timothy are seeded. As a rule the various crops are not rotated at close enough intervals. Corn frequently is grown on the same field for two or three years. This phase is somewhat more difficult to cultivate than the typical Dodgeville silt loam, chiefly because the surface soil is shallower and the underlying heavy subsoil is frequently turned up by the plow, especially along the slopes and on narrow ridges.

Farms on the shallow phase have an average value slightly lower than farms on the typical soil, which it closely resembles. The land sells for $60 to $100 an acre, and possibly more where the location and improvements are best. The value of the light phase is also lower than that of the typical soil and ranges from $40 to $70 an acre.

## CHEMICAL COMPOSITION AND MANAGEMENT OF DODGEVILLE SILT LOAM AND DODGEVILLE SILT LOAM, SHALLOW PHASE.

As indicated by the dark color of this soil it is relatively high in organic matter and nitrogen. It averages 5000 pounds of nitrogen per acre to the depth of eight inches. This is nearly twice as great as the average of the Knox silt loam, which occurs in the same region. The phosphorous is also relatively high amounting to between 1300 and 1400 pounds per acre on the average. This supply of organic matter increases the water holding capacity which is good except where the soil is too shallow over the underlying rock. It also ensures the ready maintenance of good tilth. While this supply of nitrogen and phosphorus is relatively large it must not be assumed that it can be drawn on for successive crops without reducing the fertility. The system of farming must ensure that the supply of phosphorus and nitrogen already existing is maintained or even increased in order to maintain or increase the yields of crops. So far as phosphorus is concerned this can be done by the purchase of relatively small amounts of phosphorus fertilizers regularly. Phosphorus in this form is much cheaper than in the form of feed, though if considerable bran is used on account of its food value it will make the purchase of phosphate fertilizers less necessary.

The nitrogen supply can be maintained through the growth of clover, alfalfa or other legumes. On a farm on which most of the crops grown are fed to stock and the manure carefully preserved and returned to the land the nitrogen supply can be maintained when a quarter of the farm is in clover, or in clover and alfalfa together, counting two acres of alfalfa equivalent to three of clover.

A large part of this type of soil is acid and will be greatly benefited by the use of some form of lime. Since limestone underlies practically all this section of country it can be gotten out and ground by individuals or groups of farmers using small limestone grinders to very good advantage.* Ground limestone usually can be purchased from local dealers.

This land varies in topography so that while part of it has only a gentle slope a part has quite decided slopes and is subject

*See Bulletin 230, Soil Acidity and Liming by Wisconsin Experiment Station.

to erosion. Under these conditions it will frequently be found best to use two systems of rotation of crops. On the more level portion corn and alfalfa may be grown alternately, each being on the field for three or four years, while on the more sloping land but one crop of corn should be grown in the rotation to be followed by a crop of grain used as a nurse crop for clover, timothy and other grasses so that after hay has been cut for one or two years the field can be used as pasture for three or four years before it is again broken. The methods of preventing erosion are more fully discussed under the description of the Knox silt loam. See p. 28; also in a Bulletin by the Experiment Station.†.

The adaptability of this land to pasture and the raising of hay as well as corn makes it very suitable for any line of live stock farming, but the raising of small grain is also practicable provided that proper means for the maintenance of fertility are made use of.

†Bulletin 272, Keep Our Hillsides from Washing.

# CHAPTER IV.

## GROUP OF FINE SANDY LOAMS AND FINE SANDS.

Included in this group are a number of soils of relatively minor importance, the total extent of which makes up only one-twelfth of the area of the county. For the most part they are fine sandy loams and fine sands, and in addition certain soils which are of minor importance as agricultural lands. Since these soils are adapted to special crops they really have a greater importance than their extent would indicate. Although somewhat similar in texture, there is considerable variation in origin of the soils of this group. Miami fine sandy loam and gravelly sandy loam, Carrington fine sandy loam, and Rodman gravelly sandy loam, are glacial soils and occur in gently rolling, and sometimes rough, areas. Boone fine sandy loam and Dodgeville fine sandy loam are residual soils derived from the weathering of sandstone and limestone, and have a rolling to broken topography. Fox fine sandy loam, Waukesha fine sandy loam, Plainfield fine sand, and Genesee fine sand are of alluvial origin, having been deposited as stream terraces or outwash plains, and have a level topography. Only the Genessee fine sand is subject to overflow by flood waters, the other soils lying well above the flood plain of the present streams.

### MIAMI FINE SANDY LOAM.

This type occurs most extensively in Dunkirk and Rutland Townships. It is rather variable but for the most part the surface soil is a light brown or grayish, rather silty fine sandy loam to a depth of 10 inches, underlain by yellowish-brown fine sandy loam which gradually changes into a sandy clay at 16 to 24 inches. Below 2 or 3 feet, the subsoil varies from a fine sand to a gritty clay loam. Limestone gravel is common in both soil

and subsoil, but there is seldom sufficient to decrease the value of the soil. In places the surface soil is rather lighter than the average, being a fine sand. The topography varies from gently rolling to rolling, in places it is hummocky or bumpy. Natural drainage is well developed, in the sandy areas it is sometimes excessive and the soil is somewhat droughty. Erosion is seldom injurious.

### MIAMI GRAVELLY SANDY LOAM.

This type is widely distributed over the central and eastern part of the county where it is closely associated with the Miami fine sandy loam and Miami silt loam. The surface soil is a medium to dark yellowish-brown fine to medium sandy loam of 6 to 19 inches depth. There is considerable gravel on the surface and mixed with the soil, and in places bowlders are common. The subsoil is a gritty clay loam with considerable gravel. Below 12 to 18 inches there is a gravelly sand containing varying quantities of silt and clay. This soil occurs on the tops of rounded hills or in areas of rolling or somewhat broken land. Natural drainage is very good, in some places excessive, and on the steep slopes there is some danger from erosion. Because of its sandy gravelly nature and topography, very little of the type is under cultivation, most of it being in permanent pasture. A large part is still timbered.

### RODMAN GRAVELLY SANDY LOAM.

This soil is very largely associated with the Miami silt loam. The surface soil consists of a light-brown fine sandy loam containing considerable gravel. At a depth of 6 to 12 inches this grades into stratified sand and gravel which extends to a depth greater than three feet. The surface soil is rather variable, in some places being a loam, but it is always shallow and underlain by sand and gravel. This soil occupies rolling to hilly areas or it may occur as long narrow ridges. Because of its sandy nature it is extremely droughty. This soil is used only for pasture and it supplies fairly good grazing for the spring and early summer, but the grass dries up with the first dry period and affords little grazing during the rest of the season. It is not suited to cultivated crops.

### CARRINGTON FINE SANDY LOAM.

This soil occurs in small scattered areas throughout Carrington silt loam. The surface soil is a dark brown fine sandy loam of about 10 inches depth. The subsoil is variable, but generally consists of a yellowish-brown fine sandy loam, grading into a sandy clay loam. Varying amounts of gravel are common in both surface and subsoil. In some areas the bed rock is near the surface and outcrops frequently. Where the soil is thin chert and limestone fragments are common in the subsoil. This soil occurs on the tops of narrow ridges, rounded hills and knolls and has a sloping topography. Natural drainage is somewhat excessive, and it is likely to be droughty, especially where shallow.

### BOONE FINE SANDY LOAM.

Boone fine sandy loam is confined to the southwestern portion of the county where it is associated with Knox silt loam. The surface soil has an average depth of about 10 inches and consists of light brown fine sandy loam, rather low in organic matter. The subsoil usually consists of a yellowish fine sandy loam grading into a sandy clay at about 20 inches. Sandstone occurs at some depth frequently within 3 feet. Both soil and subsoil are variable ranging from a fine sand to a loam, but fine sandy loam is the predominating texture. Frequently the subsoil is quite sandy below 18–22 inches. This type usually occupies steep slopes, and ridges where sandstone is the underlying rock. Drainage is good, and on steep slopes there is considerable damage from erosion. Only the more gently sloping portions of this type are under cultivation, the remainder serving as grazing land.

### DODGEVILLE FINE SANDY LOAM.

Dodgeville fine sandy loam occurs only in a few small areas in the southwestern part of the county where it is associated with the Dodgeville silt loam. The soil has an average depth of about 10 inches and consists of a dark brown fine sand or fine sandy loam, which is fairly high in organic matter and in places contains considerable silt. The subsoil is a brownish yellow fine sandy loam, with a small percentage of clay. Fragments of limestone and chert are common in both soil and subsoil, and bed rock is usually encountered at depths of 1 to 2 feet. Outcrops

of the underlying rock are very common. This type occurs on ridges and slopes and for the most part has a rolling or broken topography. Drainage is excessive and the soil is apt to be droughty. Because of the rocky, shallow and droughty nature it can be used only for grazing with the exception of a few small areas where the soil is deeper than usual. As a whole it has a very low agricultural value.

### FOX FINE SANDY LOAM.

Fox fine sandy loam is confined chiefly to the valley of the Wisconsin River and to the south central part of the county. The surface soil to an average depth of about 10 inches consists of a brown to light brown fine sandy loam. Litmus-tests indicate a slight acidity in places. The subsoil is a yellow-brown heavy fine sandy loam, becoming lighter in color with depth. Below 20 inches is a yellow fine sandy loam in some places continuing to 3 feet or more, in others to about 2 feet where stratified medium and fine sand is encountered. In one area north of Belleville the surface soil contains more silt than typical. The surface of the type is level to gently undulating and natural drainage is generally good.

### WAUKESHA FINE SANDY LOAM.

Soil of this type occurs principally along the Sugar River, in the vicinity of Bass Lake, in Halfway Prairie, and near Mazomanie. The surface soil has an average depth of 12 to 14 inches, and consists of a dark-brown fine sandy loam containing a comparatively high percentage of organic matter. The subsoil is a brownish yellow fine sandy loam grading into stratified sand and gravel at about 36 inches. As found in Sugar River valley and near Bass Lake the soil is a heavy fine sandy loam, while in the Halfway Prairie valley small areas of loam are included. Near the north border of the area adjacent to Mazomanie there is some evidence of wind work, where sand dunes are forming. In such areas the soil is of a lighter color than the average. Litmus paper tests indicate that this soil is strongly acid. It has a level to gently undulating topography and very good natural drainage.

# CHAPTER V.

## GROUP OF DARK-COLORED, POORLY DRAINED SOILS.

### CLYDE SILT LOAM.

*Extent and distribution.**—Clyde silt loam is confined to the central and eastern section of the county, throughout which it is widely distributed. The total area mapped is large, but there are few tracts over 1 square mile in extent. In Medina and York Townships the type occurs as long, narrow belts bordering areas of Peat, while in other places it frequently occupies the entire extent of a low, poorly drained depression.

*Description.*—The soil of Clyde silt loam to an average depth of 14 inches consists of a dark-brown or black silt loam which contains a very large percentage of organic matter. The surface is frequently covered with a mantle of peaty material 1 to 6 or 8 inches in thickness, but where the land is cleared and cultivated this becomes incorporated with the soil. The subsoil consists of a drab or bluish silt loam which grades into a silty clay loam at about 20 inches. This extends to a depth of over 3 feet, and throughout the subsoil, especially in the lower part, yellow mottlings or stains are usually found. In a few places along the Yahara River and Koshkonong Creek the black silt loam was deposited over fine sandy loam or fine sand. The black silt loam is also found over peat in a few instances. Such variations, however, are of only small extent. The type as a whole is quite uniform. Litmus-paper tests indicate that the soil is not acid.

*Topography and drainage.*—The surface of this type is level, and the natural drainage is poor. Before cultivated crops can be profitably grown, open ditches or tile drains must be in-

*The material mapped as Rough, stony land in secs. 23 and 26, T 5 N., R 8 E. should be shown as Clyde silt loam.

stalled to carry off the excess water. There is usually some fall, so that most of the areas of this soil can be successfully drained.

*Origin.*—The Clyde silt loam is largely of lacustrine and alluvial origin. It occurs as old lake beds, ponded valleys, kettle basins, and old sloughs. It also occupies the valleys of present streams. The parent material was doubtless derived from wash from the upland regions, and was either deposited in the quiet waters of lakes or by slowly moving streams. The moist conditions which prevailed favored a rank growth of vegetation, the decay of which accounts for the dark color and high organic-matter content of the soil.

*Native vegetation.*—The original forest growth consisted of ash, elm, soft maple, and willow. Most of the merchantable timber has been removed, but only a small part of the type has been cleared.

*Present agricultural development.*—Where open ditches and tiles have been installed some of the largest crops of the region have been produced on this soil. Corn has yielded as much as 80 bushels per acre and oats, 92 bushels. Grass makes a very rank growth, and timothy yields 2 tons of hay per acre. Alsike clover also does well. Small grains are likely to lodge, and the quality of the grain is not quite equal to that produced upon the upland silt loam soils of the county. Small grains can be produced with profit, however, and may well form a part of the crop rotation. Sugar beets yield 12 to 18 tons per acre, and while the sugar content is not as high as on the light-colored silt loam soils, the yield is greater and the net returns are larger. Cabbage can be grown successfully on the Clyde silt loam, but peas produce too rank a growth of vines.

The greatest need of the Clyde silt loam is drainage. It is estimated that the cost of tiling would be $25 or $35 an acre. Where thoroughly tiled, this soil will produce excellent crops.

*Chemical composition and management.*—The soil of this type has been formed by the drying up of marshes formed at the close of the glacial period and occurs associated largely with the Miami silt loam which was formed by the grinding action of the ice on limestone. These marshes, therefore, received the wash of lime from the upland and the Clyde soil now contains much more lime as a rule than the upland soils do. It is, therefore, practically never acid. The total supply of essential plant food elements in most cases is large; in some small areas soils of es-

sentially a muck character have been included in this type and there is so large an amount of organic matter in them that the mineral elements phosphorus and potassium are somewhat low.

The most marked feature of this type is the fact that the potassium in many cases is of low availability and crops, especially corn, turn yellow at an early stage and make poor growth. In such cases the use of some form of potash fertilizer or of strawy horse manure is necessary to remedy this condition. It ordinarily develops in patches of from one to several acres in extent. The phosphorus is usually ample for a number of years after drainage. But such land must eventually be manured as upland soils are or else commercial fertilizers containing phosphorus and potash must be used. There is ordinarily a much larger supply of nitrogen relatively than of phosphorus and potassium. In many cases which show a marked need of potassium during the first few years of cropping and where the soil is high in organic matter to a depth of a foot or so this special lack of potassium disappears after a few years of cropping as the result of the settling of organic matter so that deep plowing mixes up some of the subsoil high in potassium. In this case the lack of potassium is said to be "farmed out."

The first improvement in this type, of course, is in drainage so as to permit its being used for tilled crops, especially corn, to which it is adapted. In most cases a soil as heavy as a silt loam should be tiled and with the laterals not more than 5 rods apart and on an average not more than 4 rods.

## CLYDE LOAM.

Clyde loam is of very limited extent, and only a few small areas are mapped. One of these lies 1 mile west of Brooklyn and another about 2 miles northwest of the same place.

Clyde loam is an extremely variable soil, but there are a few characteristics which are uniform throughout its development. The type averages a black or dark-brown loam to a depth of about 10 to 12 inches. This is underlain by a dark-brown, drab or bluish fine sandy loam or sandy clay loam, which usually grades into a fine sand at lower depths. The subsoil is usually mottled with yellow or brown iron stains. The texture of both soil and subsoil varies, but the surface is always dark, and the underlying material is always considerably lighter in color. The mottled condition is quite uniform. Litmus-paper tests indi-

cate that the soil is seldom in an acid condition. The surface is level and the natural drainage is poor. Before profitable yields can be had, it is necessary to construct tile drains or open ditches.

This soil is of alluvial or lacustrine origin, and has been washed down from the higher adjoining soils and deposited in small lakes or streams. One of the areas mapped lies just outside of the moraine in a region of outwash material. The dark color and high organic-matter content are due to the decay of a rank vegetation, the growth of which was favored by moist conditions. This type occurs in a limestone region, and the wash from the uplands tends to correct any acid condition which might otherwise develop. The original forest growth included elm, soft maple, ash and willow. Although the greater part of the type is still uncleared, the present timber is of little value.

Clyde loam is utilized for grazing, but is too wet for cultivated crops. Where reclaimed by drainage it is adapted to the same crops as Clyde silt loam, and requires the same treatment as that type.

### CLYDE FINE SANDY LOAM.

Clyde fine sandy loam is of very limited extent. An area to the north of Middleton occupies an old lake bed. Small areas occur in the vicinity of Fish and Crystal Lakes, and other patches are scattered throughout the northern and southeastern parts of the county.

The surface soil of Clyde fine sandy loam consists of a dark brown or black fine sandy loam, ranging in a few places to a fine sand. It has an average depth of 12 inches. The percentage of organic matter present is high, and there is frequently 2 to 6 inches of peaty material over the surface. When the land is brought under cultivation, this peaty material becomes mixed with the soil. The subsoil consists of a fine sandy loam, much lighter in color than the soil, usually being drab or grayish. This frequently becomes somewhat heavier with depth, until at about 30 inches it is a silty clay loam, mottled with yellow and brownish iron stains. The subsoil, however, is variable, and frequently consists of fine sand or fine sandy loam of a white or grayish color. Litmus-paper tests indicate that this soil is acid in only a few places.

The type lies low and flat, and the natural drainage is deficient. Along the margin of some of the areas the type is high enough for crops to be grown without artificial drainage, but over most of it tile drains or open ditches are necessary for the profitable production of general farm crops.

Clyde fine sandy loam occurs in old lake beds, ponded valleys, and along the valleys of present streams. It is of alluvial and lacustrine origin, having been washed down from the higher country adjoining and deposited in lakes or stream flood plains. The moist conditions favored a rank growth of grasses and water-loving plants, the decay of which accounts for the dark color and the high organic-matter content of the soil. The original forest growth consisted of elm, soft maple, ash and willow.

Only a few areas of this soil are under cultivation at present. In the area north of Middleton, some portions of the tract have become fairly well drained by natural means—a general lowering of the water table of the adjacent lands, and are being cropped. Another tract where the conditions are somewhat similar occurs 4½ miles west of Morrisonville. With a few such exceptions most of this is in need of artificial drainage and at present is used chiefly for pasture and the production of marsh hay. It furnishes good grazing for the greater part of the season and can be used to advantage for this purpose, especially where diarying is carried on. Where properly drained it is adapted to corn, timothy, alsike clover, and small grains. It is not capable of producing small grain of as good quality as that grown on the light-colored upland soils, but profitable crops can be secured. The soil appears to be somewhat deficient in potash and phosphorus. Much the same methods outlined for the management of Clyde silt loam are applicable to this soil.

### DUNNING SILT LOAM.

Dunning silt loam has an area of less than a square mile in this county, and is confined to the Wisconsin River Valley a few miles north of Mazomanie.

The surface soil to an average depth of 12 inches consists of a dark-brown to black silt loam, high in organic matter, and containing in places a small percentage of white fine sand grains. The subsoil is a yellowish-brown silt loam containing a rather high percentage of fine sand, grading into a fine sand below 2 feet. The material forming the deep subsoil is stratified, and the

structure is loose and open. Both soil and subsoil are subject to considerable variation, especially as regards the amount of fine sand mixed with the silt, and also the depth at which this fine sand layer occurs.

The surface of this soil is nearly level. It occurs as a marsh-border soil, lying at a very slight elevation above the adjoining marsh. The natural drainage is rather poor.

This soil occurs as a second bottom and is of alluvial origin. The parent material is from the glaciated region. It was carried down when large volumes of water flowed from beneath the ice sheet, and deposited within what was then the flood plain of the river. With the recession of the ice, the stream cut a deeper channel, leaving this soil on a terrace above the present flood plain.

This type originally supported a rank growth of grasses, with scattering timber—oak, elm, willow and alders.

Only a small portion of the type is under cultivation at present, due to the poor drainage conditions. Most of the area is used for pasture, some marsh hay is cut. Before this soil can be utilized profitably the water table of the adjoining marsn will have to be lowered. Because of the open subsoil tiling for under-drainage may not be necessary on all of this soil. When sufficiently well drained, it will produce profitable yields of the general farm crops. In dry years very good yields of corn have been obtained on the higher portions of the type.

*Methods of improvement.* The methods suggested for the management of Clyde silt loam are very largely applicable to this soil. It differs from the Clyde soils chiefly in having a lower content of lime, with the result that it is frequently acid. In such cases, an application of some form of lime would prove beneficial.

### DUNNING FINE SANDY LOAM.

Dunning fine sandy loam occurs in the valley of the Wisconsin River a few miles north of Mazomanie,* and has a small total area.

The surface soil of this type consists of a loamy fine sand to fine sandy loam of a dark-brown color and extending to a depth

*The area surrounding Mazomanie in Secs. 7, 8, 9, 15, 16, 17 T. 8 N., N., R. 6 E. and marked with the letters Df should be Wf—Waukesha fine sandy loam.

of 8 inches. There is frequently a surface covering of a few inches of sandy, mucky material in which the percentage of organtic matter is very high. On cultivation the surface soils seems to become lighter, due to the mixing of the underlying sandy material with the dark surface soil. The subsoil consists of a grayinsh fine sand which extends to a depth of over 3 feet. In a few places the surface soil is a dark-brown or nearly black fine sand without the covering of muck material. Litmus tests indicate that the soil is quite strongly acid.

The surface is level. The largest area of the type, extending through the center part of Mazomanie Township, is of intermediate elevation between the ridge of Plainfield sand to the north and the peat marsh to the south, there being a gradual rise from the marsh northward. Originally much of the type was poorly drained, but through the construction of ditches the water table has been lowered so that at present a considerable portion has fair drainage. A portion of the material in sections 28 and 29 in T. 9 N., R. 6 E. has been influenced to a marked extent by wind action. In sec. 35 there is also a long narrow ridge, and at several points along the south side of the Wisconsin River there is wind worked material which in the field was classified as Dunesand, but which was included with the Dunning fine sandy loam through an error in lithographing.

This soil is of alluvial origin. The dark color is due to an accumulation of organic matter through the growth and decay of grasses when these areas were in a wet condition.

A portion of this type originally supported a heavy growth of grasses. Where timbered, willow, poplar and oak predominate.

About 75 percent of this type is under cultivation. The drainage of much of this soil has been greatly improved by the construction of a town ditch, lowering the general water table and by means of small surface ditches. General farming with dairying is the leading type of agriculture at present. On the heavier phase, fair yields of the general farm crops are obtained. The more sandy portions appear to be low in fertility, and the crops are poor.

*Chemical composition and management.*—This type is generally deficient in the mineral elements of plant food, especially phosphorus and potassium. These elements can be supplied by the use of commercial fertilizers. The acid condition of the soil should be corrected by the application of at least 1½ to 2 tons

of ground limestone to the acre. This is especially desirable for the growth of legumes, such as clover and alfalfa, as they do not make a satisfactory growth on acid soils.

Thorough drainage is the first step to be considered in the improvement of these lands. With proper fertilization and the correction of acidity very good crops of corn, potatoes, rye, buckwheat, timothy and alsike clover can be produced.

### WABASH SILT LOAM.

*Extent and distribution.*—Wabash silt loam is confined to the valley bottoms of the western portion of the county. Its total area is equivalent to more than a township, and it occurs along most of the streams as long, narrow strips.

*Description.*—The soil of Wabash silt loam to an average depth of about 14 inches consists of a black or dark-brown silt loam containing large quantities of organic matter. It is underlain by a brownish-drab or bluish silt loam or silty clay loam which is mottled with iron strains below 18 inches. This material extends to a depth of over 3 feet, and it usually becomes heaver in texture with depth. Variations in this type are common, especially along the smaller streams, where small areas might properly be classed as Meadow. In places the surface soil is light brown, and the black silt loam is encountered a few inches below. In other localities there is a peaty covering, a few inches deep, over the silt loam. In small patches both soil and subsoil are quite sandy, but all these variations mentioned are of such limited extent that they can not be indicated on the soil map. The soil as a rule is in slightly acid condition.

*Topography and drainage.*—The surface of the type is level, or gently sloping towards the stream. The soil is subject to overflow and the natural drainage is poor. Before cultivated crops can be grown successfully much of the land will require tiling.

*Origin.*—Wabash silt loam is of alluvial origin, it having been washed from the adjoining higher land by erosion, carried by the streams and deposited within the present flood plain. A rank vegetation developed under the moist conditions, and the decay of this accounts for the dark color and the high organic-matter content of the type. In some of the narrow valleys the type is partly colluvial in origin.

*Native vegetation.*—The original forest growth consisted of

willow, sycamore, elm, soft maple, and ash. Some of the timber is still standing, but it has little value.

*Present agricultural development.*—As the drainage is poor and the type usually subject to overflow, it is not used extensively for farming. It affords good pasture, however, and is highly prized for this purpose, as it occurs in a section where dairying is carried on extensively. In a few instances where the soil is properly drained, good yields are obtained, corn averaging as much as 60 bushels per acre. The main need of this type is drainage, and with the construction of open ditches and tile drains it should become one of the most productive soils of the county.

*Wabash silt loam, culluvial phase.*—This phase occurs at the base of valley slopes as narrow strips, between the flood plain and the upland, which have a gentle slope, insuring good natural drainage.

The soil is intermediate between Wabash silt loam and the surrounding upland. The surface soil to an average depth of 14 inches consists of a dark-brown to nearly black silt loam, high in organic matter. The subsoil is a yellowish-brown silt loam, which gradually becomes heavier with depth and grades into a silty clay loam at 20 to 24 inches. The silty clay loam continues to a depth of more than 3 feet. The soil is darkest where it borders typical Wabash silt loam and becomes lighter as it grades into Knox silt loam, which is light colored. In a few small spots the soil is a fine sandy loam.

This soil is largely of colluvial origin, having been washed down the slopes from the higher lands adjoining.

The greater part of the phase is under cultivation, and gives very good yields. All the crops common to the region are grown, and in addition alfalfa is grown successfully in a few places. This soil is usually included in the fields with Knox silt loam or Dodgeville silt, loam, and the methods of farming are the same as on those types.

*Wabash silt loam, terrace phase.*—Included in this phase are two quite distinct soils of very limited area, which if more extensive would have been shown as separate types.

The first occurs most extensively in the valley of the south fork of the Sugar River and one of its tributaries, 2 to 6 miles southeast of Mount Vernon. There are other small areas in Mounds Creek Hollow, and Norwegian Hollow.

The surface soil of these areas to a depth of 14 inches consists of a dark brown or black silt loam containing a very large quantity of organic matter. The subsoil is a slit loam of a drab color, mottled with iron stains. This extends to a depth of 30 to 40 inches where a drab fine sand is encountered. In a few places the subsoil is a dark-colored carbonaceous silt loam to a depth of 20 inches, where the color becomes lighter. The depth to sand is variable, in some places occuring at 18 inches. In one small area, about 3½ miles northeast of Belleville in NE¼ of Sec. 19, T. 5 N., R. 8 E., the surface soil is a fine sandy loam. The subsoil is of similar texture, but grades into a sandy clay at about 24 inches, and this into a fine sand at about 3 feet.

The surface of this soil is nearly level, with a gentle slope toward the stream along which it occurs. Owing to the topography and to the occurrence of a large number of springs, the natural drainage is poor. The soil has been formed through the weathering of stream terraces or bottoms which lie a little above the present flood plain.

On account of the poor drainage of this soil but little effort has been made to cultivate it. Tile drainage is necessary before much of it can be successfully cropped. With proper drainage the soil is capable of producing large and profitable yields of all the general farm crops.

Included with this type are areas in Black Earth Valley which are intermediate in character between the terrace phase and colluvial phase, and occur in narrow gently undulating valleys and on the adjacent colluvial slopes, with a gently sloping topography, not too steep, however, to be cultivated and with very good natural drainage.

The soil of this portion of the type is a dark brown or nearly black silt loam of about 14 inches depth, which gradually becomes lighter in color with depth, so that the lower part of the surface soil is a medium brown. Below this a yellowish-brown color develops, and the texture becomes heavier, until at 20 inches there is a heavy silt loam or silty clay loam which continues to a depth greater than 3 feet.

Most of these areas occur adjacent to Waukesha silt loam on slopes between it and the surrounding upland and it is usually farmed in conjunction with this soil. Excellent crops of corn, oats, barley and hay are raised. As these slopes receive the wash from the surrounding limestone uplands, the soil is seldom acid and has proven to be an excellent soil for alfalfa.

*Chemical composition and management.*—Since this soil has been formed recently by alluvial deposit and is largely derived as wash from the silt and finer soil from the land above, it has a larger amount of the plant food elements than older soils have as a rule. It contains from one and a half to two times as much phosphorous as the average silt loam soil and considerably more nitrogen and organic matter than the Knox and Miami types have as a rule. The potassium is approximately the same —that is, about 35,000 pounds per acre to a depth of 8 inches. Moreover, the organic matter of this soil is largely of comparatively recent origin and so is more active than the black resistant organic matter of the Waukesha, Carrington, and Dodgeville types. When this soil can be thoroughly drained and protected from overflow it is one of unusually high fertility. Nevertheless, this fertility should be maintained by proper management rather than permitted to decrease. Unless this land is fully drained it is best adapted to pasture and the growing of hay, and it must be borne in mind that these crops require large amounts of phosphorous and nitrogen and that the use of land even as pasture continually does not maintain either of these elements, and its use as meadow has the effect of exhausting the plant food rapidly. Either stable manure or mineral fertilizers containing phosphorus used in connection with a rotation including a legume which is plowed under to maintain the nitrogen and organic matter must be used.

On account of its situation along streams which are subject to considerable change in volume during the year it is rather difficult to give some tracts of this type the thorough drainage which would be necessary to fit them for tilled crops. A large part of this type of soil, however, can be fully drained by a combination of tiling and surface ditches. The tile should be laid in such a way that the main runs as far down stream as possible in order to use all the fall available. Open ditches should be developed so as to carry the water from the ravines on the side hills across the valley to the stream without permitting it to separate over the surface which has the effect of filling up slight depressions and keeping them wet for a long time after heavy rains.

When thorough drainage can be provided this land is especially suited to tilled crops making a large demand on the plant flood of the soil, such as corn and sugar beets. Acidity to a slight extent has developed in this soil more or less gen-

erally. If the land is to be used for clover or alfalfa this should be corrected; otherwise, it will not lessen the fertility of the soil until it has developed to a considerably greater degree than that at present existing.

### WABASH LOAM.

Wabash loam is confined to the stream valleys in the western portion of the county. Patches occur in Dunlap Hollow and along lower Halfway Prairie and Black Earth Creeks, also along the Sugar River 2 miles north of Belleville. Its total extent is small.

This type is extremely variable, but usually the soil to an average depth of 14 inches, consists of a dark-brown to black loam. The subsoil usually is a drab or somewhat bluish loam or fine sandy loam, which is mottled with yellow in the lower depths. The area mapped in the flood plain of Half Way Prairie Creek is predominately a fine sandy loam, but because of its limited extent and variability, was included with the loam type. The tract along the Sugar River north of Belleville is a black fine sand, but is only of about 15 acres in extent. A thin covering of peat occurs in places over the surface. In the lower subsoil fine gravel occurs in places. The material is not uniform over areas of any considerable extent.

The surface is low and flat, or has only a gentle slope toward the stream along which the type occurs, and the natural drainage is poor. It lies within present flood plains and is subject to overflow.

This soil is of alluvial origin, having been carried down the adjoining slopes and deposited in the present flood plain. The moist conditions favored a rank growth of vegetation, the decay of which accounts for the dark color of the soil. The original growth, in addition to grasses, consisted chiefly of elm, ash, soft maple, and willow.

On account of its low position, poorly drained condition and the danger from floods, this soil is used only for pasturage and to some extent for the production of marsh hay.

Draining and protecting the land from floods are the first steps necessary in improving this soil. In many cases, however, the cost of such improvement would not be justifiable. In composition this type is similar to the silt loam, though somewhat

more variable. When drained it is adapted to the same crops as silt loam and may be managed in the same way. In its present condition its use as pasture land is probably the most practicable.

## CHAPTER VI.

## GROUPS OF MISCELLANEOUS SOILS.

### ROUGH STONY LAND.

Rough stony land is very largely confined to the western part of the county, where it is associated with the Knox silt loam. Areas of this type consist mainly of steep, rocky slopes and cliffs, too rough to plow or to cultivate profitably. Where there is a covering of soil over the rocks it is thin, and is usually filled with rock fragments. The texture of the soil varies from a silt loam to a fine sand or fine sandy loam. This type occupies the steepest portions of ravine and valley walls. The outcropping rock consists of limestone and sandstone, while the thin soil covering has resulted from the weathering of these formations and from the wash from higher lying lands. Much of the forest growth, consisting of oak, hickory and a few birch, is still standing. Rough stony land is non-agricultural* and of value only for the small amount of timber and pasturage which it affords.

### MADE LAND.

Made land includes poorly drained areas in and about the city of Madison, which have been filled in artificially. Originally the soil was Clyde silt loam, Muck or Peat. In most cases such tracts have been covered by pumping sand from adjoining lakes, but in some instances soil has been hauled from higher lying areas. It is quite common to cover the sand with a thin veneer of "clay." These areas are not used for agriculture, but are platted into small lots and sold for building sites.

### MEADOW.

Meadow comprises first bottom land along the Wisconsin River subject to annual overflow, where the texture of the soil

*The material mapped as Rough stony land in sections 23 and 26 in T. 5 N., R. 8 E., should be Clyde silt loam.

is so variable that no satisfactory classification into established types can be made. The texture ranges from a fine to a medium sand, with occasional small areas that are much heavier, while the color varies from light brown to nearly black. In a few places there is a shallow covering of peat. The surface is nearly flat, and lies only a few feet above the level of the adjoining river, so that drainage is deficient in depressions. The soil of these areas is of alluvial origin, having been deposited by the waters of the Wisconsin River. Much of the tract is timbered with ascattered growth of soft maple, willow, elm and ash. About the only agricultural uses to which these tracts can be put are for pasture and hay land.

# CHAPTER VII.

## GROUP OF MARSH SOILS.

### PEAT.

*Extent and distribution.*—Peat is extensively developed in Dane County, and is widely distributed throughout the glaciated region. The largest areas occur in the northeastern part of the county in Burke, Sun Prairie, Medina, York, Deerfield, Cottage Grove, and Blooming Grove Townships. Smaller areas are encountered in the southeastern, southcentral, and extreme northwestern sections.

*Description.*—The soil mapped as Peat consists of black or dark-brown vegetable matter in varying stages of decomposition, with which there is incorporated a small percentage of mineral matter. It ranges in depth from 2 to about 20 feet, with an average of probably 5 feet. The greater part of the Peat is quite fibrous, though in a number of places it is fairly well decomposed and tenacious, so that it can be molded into different forms by the hands. When dry this well-decomposed Peat somewhat resembles a black carbonaceous clay. Where encountered in areas of sandy soils the underlying material is frequently sandy, while in regions of heavy upland soils the underlying material is clayey in character. Most of the areas of Peat are underlain by material as heavy as a loam or heavier. The largest areas underlain by sand occur in the valley of the Wisconsin River in the northwestern part of the county. In this region there are a few small sand "islands" in the Peat areas and in places the underlying sand is nearer the surface than usual. Practically all of the other large Peat marshes within the county are underlain by heavy material.

*Topography and drainage.*—The Peat areas are low, level, and very poorly drained. During early spring some of the marshes are entirely covered with water, while later in the summer many tracts are dry enough and firm enough to bear the weight of farm animals, so that they can be pastured or cut for

hay where there is a growth of wild grasses. The natural drainage courses have been deepened and large open ditchs constructed in a number of the marshes, and a considerable part of this land is being reclaimed and transformed into productive fields.

*Origin.*—The Peat has been formed through the growth and partial decomposition in the presence of water of a rank vegetation, the black or dark-colored material being formed largely from grasses and sedges, and that having a brown color chiefly from sphagnum moss. About the margin of the larger marshes, and over the greater part of the smaller ones, varying quantities of soil from the adjoining higher land have been washed in and incorporated with the vegetable matter. Wherever this is sufficient to change materially the texture and structure of the material it is separated and mapped as Muck. The peat beds occupy old lake basins, ponded valleys, kettle basins, glacial sloughs, and other depressions in the uneven surface developed by the glacial ice sheet. Peat may also be found within the flood plain of many of the streams. Although the greater part of the Peat occurs within a region where the upland soils are made up in part of limestone material, some of it is in an acid condition. This is usually the case in the center of the larger marshes, while many of the smaller ones are not thus affected.

*Native vegetation.*—The native growth consists chiefly of several varieties of grasses, sedges, and some arrowhead, cat-tail, and various reeds and rushes. Some of the sphagnum moss peat beds support a growth of tamarack, sumac, huckleberry, and some quaking aspen. Where the Peat is shallow, elm and ash are sometimes found.

## MUCK.

Muck consists of vegetable matter in varying stages of decomposition, with which there is incorporated large quantities of mineral matter. It may be considered as intermediate between Peat and the soils of the Clyde series. In some places the surface material is Peat, but is underlain at 10 to 14 inches by silt loam or silty clay loam, and such tracts can not well be classified with the true Peat.

Muck is not of large extent in this county, and it occurs only in small tracts scattered throughout the glaciated section. It occupies about the same topographic position as Peat, and is

VIEW OF RECLAIMED PEAT LAND NEAR DEERFIELD.

There are over 50 000 acres of this kind of marsh land in Dane County, nearly all of which can be reclaimed. At present comparatively little of the marsh land is under cultivation.

[illegible] RECLAIMED PEAT LAND. THIS IS PART OF THE SAME MARSH SHOWN IN PLATE IX.

poorly drained and usually in a swampy condition. It is so situated that most of it could be drained along with the Peat. With drainage well established the material is very productive. In its present condition, however, its only value is for the pasturage it affords and the marsh hay which is cut from some areas.

AGRICULTURAL VALUE AND DEVELOPMENT OF PEAT AND MUCK.

The large amount of marsh land occurring in Dane County so well located with reference to market and transportation facilities makes it important to consider its agricultural possibilities quite fully.

The question of the actual value of marsh land is one which depends on several factors. In the first place, the farmer whose land is largely upland and well drained can use a small amount of marsh land to very much better advantage than can the farmer whose land is essentially all marsh land. But probably the most important factor determining the value of marsh land will be the crops which can be grown on it. This depends on two factors, first the degree of drainage, and second the danger from frost. When only the main outlet and lateral ditches have been installed, in the great majority of cases hay crops are the only ones which can be safely grown, and the character of the hay will also depend a good deal on the character of the drainage. In the case of peat land underlaid by sand the drainage by well-constructed and sufficiently deep ditches 40 to 80 rods apart will, in most cases, give adequate drainage for this purpose. When the peat soil is underlaid by silt or clay, however, ditches not more than 20 rods apart will be necessary and these must lower the water in the ditch to a point 4 to 5 feet below the surface during part of the growing period. When tilled crops, such as corn, cabbage, or potatoes, or small grains are to be grown, the drainage must be more certain, and over the greater portion of our marsh lands this will mean the installation of drainage systems in the form of either open lateral ditches or of tile not more than 10 and often not more than 5 rods apart on the average.

Another factor which must be considered in comparing marsh and upland soils is that of fertility as determined by chemical composition. Marsh lands are abundantly supplied with organic matter containing nitrogen, but are relatively low in the elements phosphorous and potassium. The marsh lands of Dane County are rarely acid since the acidity which ordinarily

... OF CORN GROWING ON RECLAIMED PEAT LAND. THIS IS PART OF THE SAME MARSH SHOWN IN PLATE IX.

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develops in marsh land is kept neutralized by the lime carried down from surrounding uplands. Stable manure can be used for fertilizing marsh land but it contains large amounts of nitrogen, which the marsh soil does not need and is relatively low in phosphorous and contains but a moderate amount of potassium. Moreover, weeds so commonly carried into the land with stable manure are especially hard to eradicate on this class of soil. Ordinarily, therefore, it is more satisfactory to use commercial fertilizers containing phosphorous and potassium on marsh soils than stable manure. At any rate this is true when the farm contains some upland soils as well as marsh land, since the stable manure can be used on the upland while the commercial fertilizers are secured for use on marsh land.

Marsh lands are more subject to early fall and late spring frosts than are uplands, partly because of the fact that the cold air developing in contact with the soil as the latter loses its heat by radiation during the night, flows down and collects over the lower land, and partly because the loose, spongy nature of the peat soil prevents the heat of the sun from penetrating so that all except the mere surface is cool, and this loses its heat quickly at night, therefore increasing the tendency to frost. This loose character of the soil can be somewhat improved by the use of a heavy roller which firms the soil and so gives it better heat conductivity. This tendency to frost reduces somewhat the availability of marsh land for tender crops, but in Dane County, potatoes and early varieties of corn on marsh lands are seldom injured by frost.

The large water-holding capacity of marsh soils together with their large quantity of nitrogen makes them suitable for crops, making strong growth of stock or leaf. Among the staple crops, hay and corn are best suited to such land. Special crops such as cabbage, hemp and sugar beets also do well, but these will require larger amounts of potassium and phosphorous fertilizers. The degree of drainage must also be considered in selecting the crop to be grown. Timothy and alsike clover for hay may be grown on marsh land having insufficient drainage to be adapted to corn or other crops requiring tillage.

# CHAPTER VIII.

## GENERAL AGRICULTURE OF DANE COUNTY.

Agriculture was first practiced in Dane County about 1830. The first settlers selected the rolling timber land because of the ease of obtaining wood and water, and also on account of the protection from the winter weather. Settlers from Ohio and Illinois who were accustomed to farming on prairie land located more often along the edge of the prairies, and as the population increased the prairie lands were gradually taken up. The early agriculture consisted mainly of grain production, with the growing of enough garden and truck crops to supply the needs of the family. For many years the grains, including wheat, oats, barley, rye, and flax, were by far the most important crops grown, and of these wheat was much the most important. For a number of years it exceeded all other crops combined. Wheat was in many cases grown in the same field for a long period of years. At first the virgin soil produced excellent yields, but the continued cropping, together with the ravages of the chinch bug, so reduced the yields that the crop could not be produced with profit. Grain production gradually gave way to a more diversified system of farming. Corn and oats proved to be profitable, and the raising and feeding of stock gradually developed into an important dairy industry. Tobacco was introduced into Dane County by settlers from Ohio as early as 1853, and was grown on the "prairies" in the southeastern section. From this beginning tobacco developed into an important crop. It is still grown extensively, mainly by Norwegians, in the southeastern part of the county.

The type of agriculture most extensively followed in Dane County at the present time consists of general farming in conjunction with dairying. A number of special crops receive attiontion, and among these tobacco is by far the most important. Peas, sugar beets, and potatoes are grown. The general farm

crops are corn, oats, barley, rye, wheat, buckwheat, timothy, clover, and alfalfa.

Corn is grown more extensively than any of the other cultivated crops. In 1909, according to the census, 107,182 acres were devoted to corn, with a production of 3,501,937 bushels. White and yellow dent varieties are most popular. The corn is usually cut with a harvester and husked from the shock, the stover being stacked in the field or shredded and stored in the barn for coarse winter feed. In recent years many silos have been built and a large part of the corn is now used for ensilage.

Oats are second in importance to corn. The census of 1910 reports 99,968 acres in oats in the county, with a production of 3,157,306 bushels. Practically the entire crop is used for feed on the farms, comparatively little being placed on the market. Miami silt loam and the better areas of Knox silt loam produce oats of the highest quality, though Carrington silt loam and other black prairie types often give larger yields per acre.

Barley is an important crop in many sections. With a number of farmers it is the chief cash crop grown. In 1909 there were 34,873 acres in barley, producing a total of 910,388 bushels. The acreage devoted to this crop has been gradually decreasing, chiefly because of a reduction in the yields obtained. The barley is grown almost entirely on the heavy soils of the county.

Rye is not grown extensively, but in some parts of the county it is an important crop. From 3,247 acres in 1909 a total volume of 46,003 bushels was harvested. The growing of rye is confined almost entirely to the sandy types of soil. It is planted as a grain crop, for green manuring, and for pasturage. On the sandy loam types very satisfactory yields are usual, and during years of at least normal rainfall good crops are often obtained on some of the more sandy types.

The acreage devoted to wheat, which was at one time the most important crop in the county, is at present small. The 1910 census reports 2,522 acres in wheat, with a production of 48,595 bushels. Although the average yields are low, where grown in a good crop rotation wheat usually gives very satisfactory yields.

Buckwheat is grown to a very small extent and is confined largely to the low sandy soils of the county. In 1909, 225 acres in the county were devoted to buckwheat, producing 4,218 bushels.

Of the hay crops grown in Dane County timothy and clover are the most important. It is the common practice to sow these together, with some small grain as a nurse crop. The medium red is the most popular clover grown. Some difficulty has been experienced in getting a good stand of clover during recent years, owing to winter-killing in the late winter, when the ground is alternately freezing and thawing. On certain types of soil an acid condition exists, which is detrimental to best results with leguminous plants, including clover. On the heavier soils and where drainage is somewhat deficient alsike is being grown to a considerable extent, as a stand can usually be obtained more easily than with the medium red clover. Mammoth clover does well on the lighter soils, but on the heavy types it is coarse and not so satisfactory as the medium red. Both timothy and clover are sometimes seeded alone and cut for seed as well as for hay. Over the low, marshy tracts within the county many tons of marsh hay are cut each year, but this is of inferior quality.

Alfalfa is becoming a very important crop, especially in the dairy districts. Three cuttings can always be counted on, and the average yield per acre is 3 tons per year. Alfalfa can be grown on many of the different soil types in the county when the soil is put in proper condition. A good stand is always gotten where the field is inoculated, well supplied with stable manure, and in a sweet condition. It is a good practice to sow a small quantity of alfalfa seed with clover and timothy so as to get the field inoculated for the alfalfa crop.

The acreage of emmer and spelt grown in Dane County in 1909 was small. A total of 226 acres produced 7,875 bushels.

In addition to the general farm crops, several others which may be classed as special crops are produced, and among these the most important are tobacco, potatoes, sugar beets and peas.

Dane County holds first place in Wisconsin in the production of tobacco. In 1909, of a total acreage of 40,458 acres devoted to this leaf within the State, 16,789 acres were in Dane County, and the output for the county is reported as 20,932,967 pounds. Almost one-half of this was produced in the four southeastern townships of the county. Stoughton, in Dane County, and Edgerton, just across the line in Rock County, are approximately the center of Wisconsin's tobacco-growing section. Most of the tabocca grown is of the Comstock's Spanish variety. About 85 per cent is sold as binder tobacco, and the remainder,

consisting chiefly of broken leaves and stems, as filler. Binder tobacco usually sells for 7 to 14 cents a pound, and filler for about 2 cents a pound. The average yield is about 1,200 pounds per acre. Tobacco is grown most extensively on Carrington and Miami silt loams. The choicest land for tobacco appears to be near areas of Carrington fine sandy loam where there is just a little sand mixed with the silt.

The crop is fertilized with stable manure, very little commercial fertilizer being used. In order to maintain the productiveness of the tobacco land and provide a very rich soil, 20 to 40 loads of manure are applied per acre. As about 10 acres of tobacco are grown on the average by each of the planters in the tobacco section, it takes all of the manure produced on the farm to supply this one field, and as a result the remainder of the farm can not be manured.

This practice of applying practically all the manure of the farm to the tobacco fields has a bad effect on the remainder of the farm which in many instances is not farmed profitably. When tobacco or any other special crop requiring heavy manure is grown, some method of increasing the nitrogen and organic matter should be used so that a part at least of the manure can be used on the other parts of the farm. It would be possible on most farms on which tobacco is grown to use two fields for this crop alternately. After tobacco has been grown three years on a field, this field could be planted the next year to corn, the second to oats seeded to clover, and the second growth of clover grown during the third year should be plowed under to increase the organic matter and to secure the nitrogen which tobacco needs. If on this clover sod a good application of commercial fertilizers containing right amounts of phosphorus and potassium is made, this will make unnecessary the use of manure on the field for that year, and the amount for the next year may be lessened, so that about one-half the manure would be available for other fields on the farm.

If in addition to this, proper rotation be maintained on the remainder of the farm so that clover be grown every third or fourth year, and as far as possible the second growth of clover plowed under, this will overcome much of the difficulty of maintaining the fertility on tobacco farms.

This practice of growing clover alternately will also reduce the amount of erosion or washing which is often quite serious

on tobacco fields on side hills. It is probable that some kind of green manuring crop could also be sown in the tobacco field at the last cultivation so as to still further increase the supply of organic matter. This interchange of fields for tobacco will also assist in preventing the development of diseases to which this crop is subject.

Potatoes, while not an important crop commercially, are grown quite generally in small fields in the sandy sections of the county, and in all parts the tuber is grown to a sufficient extent to supply home needs. The 1910 census reports 5,883 acres in potatoes in 1909, with a production of 679,675 bushels. The Early Rose, Early Ohio, Rural New Yorker, and Peerless are among the varieties most commonly grown.

Sugar beets are grown quite extensively on some of the heavier types of soil, chiefly Carrington silt loam and Miami silt loam. In 1909, from 1,247 acres, a production of 14,060 tons is reported. A beet-sugar factory is located at Madison, and a large percentage of the best tonnage is shipped to this point. It is customary for the farmers to put in the crop and attend to the implement cultivation, while the factory furnishes labor to do the hand work, such as thinning, weeding, and topping, for which a charge of $20 per acre is made. Yields range from 8 to 18 tons per acre, and the usual selling price f. o. b. is $5.50 to $6 per ton, depending upon the sugar content. The sugar content of beets grown on Miami silt loam is a little higher than that of those grown on Carrington silt loam or other dark-colored soils, but the yield is usually higher on the dark soils, and the net returns usually a little larger than from the light-colored types. The sugar beet is a heavy feeder and the soil must be highly fertile to produce the largest yields which are necessary to profit in the growing of this crop. If sugar beets are to be grown regularly to any extent proper care must be taken that they are not grown at the expense of other crops by the use of the largest part of the manure of the farm on the beet field. If they are grown on land on which a good second growth of clover or other legume has been plowed under and to which some commercial fertilizers have been added, the amount of manure used can be greatly lessened. This will not only assist in maintaining the fertility of the farm as a whole but will reduce the difficulty in keeping the beet fields free from weeds. The proper fertilizers to use in this way will depend on the type

of soil. When beets are to be grown on upland light-colored soil or clay loam soil, the fertilizers should be one containing chiefly available phosphorus, such as acid phosphate or ground steamed bone meal. When the beets are being grown on black or marshy soil fertilizers should be high in potash but should also contain phosphorus.

Peas for canning and also for seed are grown quite extensively in the northeastern part of the county and to a small extent in the northwestern section. One canning factory is located within the county, at Sun Prairie. A large factory is operated at Columbus, which is but a few miles distant from the northeastern corner of the county. Another factory is located at Sauk City, a few miles from the northwestern corner of the county. Yields range from 2,000 to 2,200 pounds per acre of shelled peas for canning, for which the farmers received 2 to 2½ cents per pound. In order to obviate long hauls viners are located throughout the pea-growing sections, making possible the extension of the industry beyond the immediate vicinity of the canning factory. In sections too far removed from factory and viners seed peas are grown. The usual yields range from 15 to 20 bushels per acre, and the price varies from $1.50 to $2 per bushel. The varieties chiefly grown are the Alaska, a very early pea, and the Advance, Admiral, and Horseford, which are later. Peas are proving to be profitable, and, being a legume, they get part of their nitrogen from the air through the nodules on the roots but probably do not take nearly as large a part of their nitrogen in this way as do clover and alfalfa. Moreover where the vines are removed from the farm nearly all the nitrogen goes with them as the root system is small. On the whole therefore it is best to think of the pea as one would of corn and grow in rotation on a clover sod or on land which has been manured.

The pea is greatly benefited by the use of ground limestone on land which is acid. Miami silt loam has been found especially suited to peas. They also do well on Carrington silt loam, but the quality is not quite so high as of those grown on Miami silt loam.

The growing of truck crops on a commercial scale has been developed in the immediate vicinity of Madison, where most of the common vegetables are grown for the city market. Some of the sandy types of the county are very well adapted to the truck-

ing industry. Nearly every farm has a garden in which most of the common vegetables are grown for home use, but there are only a few places in the vicinity of towns where trucking is engaged in on a commercial scale.

The fruit industry has not been developed commercially, except in a few orchards, chiefly in the vicinity of Madison, where small fruits and berries, such as raspberries, blackberries, currants, and strawberries, are grown. Apples are grown in small orchards on many of the farms, but there are no large commercial orchards within the county. There are a large number of excellent orchard sites, especially in the western and southwestern parts of the county, where the soils are favorable for apple culture, and it would seem that apple growing could be profitably developed on a commercial scale.

Considered from the standpoint of returns, dairying is the most important industry in Dane County. In 1913 there were within the county 90 cheese factories, 50 creameries, and 4 skimming stations, and a large condensery is located at Middleton.

In the western and southwestern sections of the county, where the surface is quite rough and broken, and where corn can not be grown as profitably as in other sections, mainly on account of the danger from erosion on the steep slopes, farming conditions are somewhat different from those in sections where the topography will permit the extensive growing of all intertilled crops. The Swiss cheese industry which centers in Green County to the south is developed to a considerable extent in the southwestern part of Dane County. A somewhat higher altitude and consequent cooler nights together with the fine quality of the pasture grasses are favorable conditions for this variety of cheese. In other sections of the county creameries are more numerous, corn is grown more extensively, and hog raising is a more important branch of agriculture.

In the production of beef cattle Dane County ranks first in the State. Throughout the tobacco-growing section, where dairying is of little importance, it is a common practice to fatten cattle each year in conjunction with the general farming operations which are carried on by the tobacco growers. In other parts of the county the feeding of beef cattle is a minor activity.

Horses are raised on many farms, but seldom as the main pro-

duct. Most farmers raise their own work stock, and frequently horses are sold. The quality of the sires used is gradually being improved, with the result that larger and better work horses are taking the place of the smaller stock.

Sheep are raised only to a comparatively small extent. It is a fact that sheep are not raised as extensively in the rougher portions of the county, where there is a large acreage of grazing land, as in the sections where land values are higher and where the soil is well adapted to a large variety of cultivated crops. There are several flocks of purebred sheep, but the total number of sheep in the county is small. It would seem that the rougher land in the southwestern part of the county would be very well adapted to the sheep raising business. The use of side hills for pasturage would greatly reduce the erosion or wash to which this land is subject when in cultivated crops.

Hog raising is carried on quite extensively in all parts of the county except the southwestern section, where cheese production is important. Hogs are most numerous in sections where butter is the chief dairy product.

Farmers are beginning to realize the value of the adaptation of crops to soils. It is generally recognized that certain crops produce higher yields and are of better quality on certain soils than on others. Peas, for instance, appear to do best on Miami silt loam. Corn makes its best growth on the dark-colored soils, such as Carrington silt loam, Dodgeville silt loam, and Waukesha silt loam. On these dark soils, having a large percentage of organic matter, small grains are likely to lodge and the quality of the grain is not so good as on the light-colored heavy soils of the county. The grasses appear to do best on the dark-colored soils of heavy texture. Potatoes of the best quality are grown on the sandy and sandy loam types. Local conditions, however, often are such as to make it impossible to conform strictly to the growing of crops best adapted to a given soil. Since a rotation of crops is almost imperative in order to assist in the eradication of weeds and to make it possible to apply the manure on the farm to the crop most needing it, it is impossible to adapt the crop completely to the type of soil on which it is grown, but the system of farming followed on each farm should be that in which the crops best suited to the predominating type of soil are grown as extensively as possible. That is to say, on dark colored prairie soils corn should be grown and used to a large extent, while relatively less small

grain should be grown. On a more rolling land of lighter-colored soils pasture should be used more extensively, more small grains should be grown and less dependence put on corn.

A rotation quite common for the light-colored, heavy-textured soils of the county consists of corn one year, followed by oats, and then barley, or wheat seeded with timothy and clover. Hay is usually cut for two years before the field is again plowed for corn. On the prairie soils corn is quite often grown two years in succession, and followed by grain and hay crops.

The most troublesome weeds in Dane County probably are the Canada thistle, quack grass, wild mustard, and wild morning glory. The amount of damage caused by such pests is not fully appreciated, and there is a general need of additional efforts toward their eradication.

The farm buildings throughout the county, as a rule, are well constructed, substantial, and kept in good repair. The silo forms a part of the equipment of most of the dairy farms. The fields are generally well fenced, and woven wire is coming into common use.

Windmills are quite common, though on many farms gasoline engines are used for pumping water and running various kinds of the lighter machinery. In general the appearance of the farmsteads indicates thrifty and prosperous agricultural conditions.

The supply of hired help for the farms is usually limited. The members of the family do most of the farm work. Farm laborers are usually paid $30 to $40 per month with board. During haying and harvesting, day laborers are paid $1.50 to $2, and sometimes as much as $2.50. During the season of 1913, tobacco laborers hoeing and harvesting the crop, received $3 and $3.50 per day.

The census of 1910 reports a total of 6,058 farms in Dane County, comprising 95.7 per cent of its area. Of these farms, 73.2 per cent are operated by the owners, the remainder being divided in the ratio of about 3 to 2 between share and cash tenants. The average size of the farm is 122 acres, of which on an average 88 acres are improved.

The value of farm land varies widely with the different types of soil. The highest priced land in the county is in the tobacco growing section, where small farms of choice tobacco lands are held at prices in the vicinity of $200 to $250 an acre, and some at even a higher figure. Larger farms on Carrington silt loam

and Miami silt loam are valued at $125 to $150 an acre. On the other hand, some of the farms on the sand types are held at $25 to $40 an acre. In the driftless region land values depend on the percentage of rough, steep land included in a farm, and the prices range from $40 to about $125 or more an acre. Location, character of soil, and improvements are factors which determine the value of farm land. The average value of land in Dane County was reported in the 1900 census as $41.20 an acre. In 1910 the average value is given as $72.73.

Although the agriculture of Dane County is in a comparatively high state of development, there are certain lines along which improvement is needed. One great deficiency of all the light-colored soils of the county is organic matter. This is effectively supplied by supplementing the stable manure with green-manuring crops, of which the legumes are the best. By increasing the supply of organic matter, not only is plant food added but the water-holding capacity of the soil is increased and the structure of the heavy soils is improved. Litmus tests made during the progress of the survey indicate that an acid condition exists in some of the types. This condition can be corrected by the application of ground limestone or some other form of lime. Before alfalfa can be grown successfully the soil should be in a sweet condition and inoculated. There is a general need for greater attention to the systematic rotation of crops in order to secure combinations best suited to soil conditions on the farm. More thorough methods of cultivation, especially of intertilled crops, are needed. Thorough cultivation helps to conserve soil moisture. As a rule the selection of seed does not receive proper attention.

With certain special crops, such as tobacco and sugar beets, commercial fertilizers, properly tested, are valuable as a supplement to stable manure, of which the supply is usually inadequate. The growing of alfalfa and of other legumes, such as peas and beans, is beneficial to the soil and could be profitably extended.

The drainage of wet lands affords an extensive field for development. Aside from the large marshes, there are on many farms small patches of wet land which could be tilled at little expense, materially increasing the productive area of the farms. Many areas of Peat, with proper drainage, are capable of producing profitable crops. Land values are so high as to encourage the reclamation of nonproducing tracts.

# CHAPTER IX.

## CLIMATE.*

"Among the factors which influence the agriculture of a State none is more important than the climate. The class of crops which can be grown is largely determined by the length of the growing season and the amount and distribution of the rainfall, so that the climate may determine the type of agriculture which can be practiced to best advantage."

"The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation ranging from 28 to 34 inches, while the mean for the State as a whole is 31 inches. This is a slightly heavier rainfall than is received by eastern England, northern France and most of Germany and Sweden. As compared with other sections of this country, Wisconsin has a total rainfall equal to that of central Oklahoma and Kansas, northern Iowa, Michigan, northwestern New York, or the Puget Sound Basin of Washington. Owing to its northern location, however, the lessened evaporation probably makes the precipitation as effective as that of Arkansas, Illinois, or Virginia."

The local distribution of rainfall varies, however, from year to year, the variation being caused by the movement of cyclonic storms. Since authentic records have been kept the average rainfall for the State during the driest year was 21.4 inches and during the wettest year 37 inches. For Dane County the total precipitation for the driest year recorded was 13.49 inches and for the wettest year 52.91 inches. The mean annual precipitation is 31.25 inches.

"Of equal importance in agriculture to the total amount of rainfall is its seasonal distribution, and in this respect Wisconsin is favorably situated, since about half of the total rainfall occurs in May, June, July, and August, and nearly 70 per cent

*Ths chapter has been taken largely from Wisconsin Bulletin 223 on The Climate of Wisconsin and its Relation to Agriculture. This bulletin should be consulted if more information is desired concerning climate. All quotations indicated are taken from this bulletin.

from April to September, inclusive. The rainfall is heaviest in June, averaging 4.01 inches, while in July it averages 3.8 inches and in May 3.66 inches. The precipitation during the winter, on the other hand, is slight, December, January, and February each averaging somewhat over 1.5 inches. The average rainfall for the State during the winter is 3.9 inches, during spring 8.3 inches, summer 11.4 inches, and fall 7.4 inches. For Dane County it is 4.85 inches during the winter, 8.28 inches during the spring, 10.96 inches for the summer months, and 7.16 inches for the fall. Most of the rainfall occurs just preceding and during the period of plant growth; thus, the growing season—April to September, inclusive—has an average of 20.24 inches, which is as much rain as is received during the same months by eastern Texas, Illinois, Ohio, or eastern New York. Owing to the small winter precipitation, on the other hand, there is practically no leaching of fertility from the soil or erosion."

Another phase of rainfall distribution of great importance is its variation within a period of a few weeks. Frequently periods of drought and periods of unusually heavy rainfall occur, continuing for one week to four weeks and occasionally longer. Observations taken at Madison over a period of thirty years, from 1882 to 1911, inclusive, show that there are on the average three ten-day periods during each growing season when the amount of rainfall is so slight that crops on a moderately heavy soil, such as the Miami silt loam, actually suffer from lack of moisture.

The eastern and southeastern sections of Dane County are included within the Rock River Basin, which is one of the eight climatic provinces in Wisconsin. This section has the longest growing season of any in the State, averaging about 170 days, which is as long as that of central Illinois, longer than that of central Indiana or Ohio, and about equal to that of the Valley of Virginia and that of central Maryland. The mean annual temperature in Dane County is 45.7° F. The winters here are cooler than along the Lake, and the springs and summers are warmer. This section is the best corn area in the State. The temperature of the Rock River Basin in summer is similar to that of northern Illinois, Indiana, Ohio, and southwestern Pennsylvania, while in winter it is comparable with that of southern Vermont, northern Iowa, or Montana. During seven summer days on the average each year the thermometer may go as high as 90° and during five winter mornings on an average it may

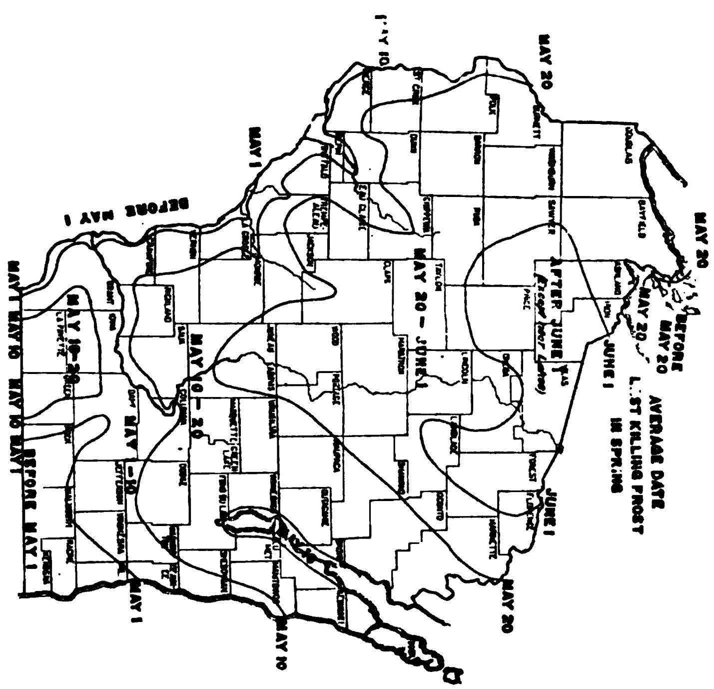


FIG. 2. Sketch map showing the average dates of the last killing frost in the spring.

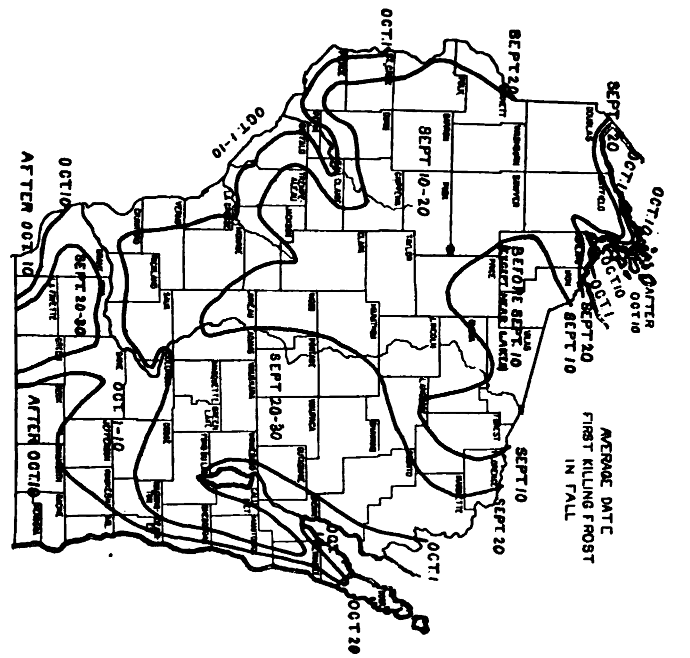


FIG. 3. Sketch map showing the average dates of the first killing frost in the fall.

fall to 10° below zero or lower. The highest temperature recorded in the county is 104° F., and the lowest—29° F. Such extremes are of rare occurrence and of short duration. The southwestern and a part of the western sections of Dane County have a somewhat shorter growing season, and are included in what is known as the Southern Highlands. The average elevation is somewhat greater than that of the eastern and southeastern parts of the county and the growing season ranges from ten to twenty days shorter.

The average date of the last killing frost in the spring is April 22; the latest date of killing frost recorded is May 13. The average date of the first killing frost in the fall is October 18, while the earliest date recorded is September 29.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau station at Madison:

*Normal monthly, seasonal, and annual temperature and precipitation at Madison.*

| Month | Temperature. | | | Precipitation | | |
|---|---|---|---|---|---|---|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. |
| | °F. | °F. | °F. | Inches. | Inches. | Inches. |
| December | 22.8 | 60 | −28 | 1.72 | 1.80 | 1.32 |
| January | 16.9 | 58 | −29 | 1.63 | 1.12 | 2.05 |
| February | 18.7 | 63 | −28 | 1.50 | 0.26 | 5.42 |
| Winter | 19.5 | | | 4.85 | 3.18 | 8.79 |
| March | 30.4 | 86 | −12 | 2.08 | 0.27 | 4.34 |
| April | 45.6 | 86 | 8 | 2.54 | 1.06 | 1.50 |
| May | 57.6 | 90 | 23 | 3.66 | 2.58 | 4.25 |
| Spring | 44.5 | | | 8.25 | 3.91 | 10.09 |
| June | 67.3 | 98 | 38 | 4.01 | 0.59 | 4.15 |
| July | 72.0 | 104 | 48 | 3.80 | 1.21 | 9.47 |
| August | 69.8 | 96 | 46 | 3.15 | 2.08 | 0.56 |
| Summer | 69.7 | | | 10.96 | 3.88 | 14.18 |
| September | 62.3 | 93 | 29 | 3.08 | 0.91 | 8.17 |
| October | 50.0 | 84 | 12 | 2.32 | 0.58 | 9.12 |
| November | 35.1 | 69 | −14 | 1.76 | 1.03 | 2.56 |
| Fall | 49.1 | | | 7.16 | 2.52 | 19.85 |
| Year | 45.7 | 104 | −29 | 31.25 | 13.49 | 52.91 |

## SUMMARY

Dane County is located in the south-central part of Wisconsin, and comprises an area of 1,202 square miles, or 769,280 acres. The surface varies from level or gently undulating prairies and outwash plains to hilly and broken country. From the standpoints of physiography and geology the county falls naturally into two broad divisions—the driftless western part of the county, where the surface configuration is largely the result of erosion, and the remainder of the county, which has been greatly influenced by glacial action and has a more even topography.

The drainage of the northwestern part of Dane County is directly into the Wisconsin River. The remainder is drained through the Yahara and Sugar Rivers and their tributaries into the Rock River and thence into the Mississippi.

The first permanent settlements in Dane County were made about 1830. The first settlers were interested in mining, but agriculture soon developed, and the county is now one of the most highly improved in the State. Madison, the county seat and the capital of the State, is an important railroad center and has a population of 25,531, according to the 1910 census. The population of the county is reported as 77,435. The entire county is well supplied with transportation facilities, and all sections are well settled.

The climatic conditions in this part of Wisconsin are favorable for the development of general farming and dairying. The mean annual temperature at Madison is 45.7°, and the mean annual precipitation is 31.25 inches. On the average, during each of the months of May, June, July, August, and September, there is more than three inches of rainfall. The rainfall is usually fairly well distributed, but there are occasionally short periods of drought or of excessive rainfall.

The general type of agriculture in Dane County consists of general farming in conjunction with dairying. In 1913 there were 90 cheese factories and 50 creameries in the county. The common farm crops are corn, oats, barley, clover, timothy, alfalfa, wheat, and rye. In addition a number of special crops are grown, including tobacco, potatoes, peas, and sugar beets.

Some beef cattle are fed, chiefly in the tobacco-growing districts, but the raising of beef cattle is unimportant as compared

with the dairy industry. Hog raising is carried on quite extensively, and a few sheep and horses are raised in the county.

Agriculture is highly developed in nearly all sections. Land values range from about $25 an acre in the sandy and rough areas, to $250 or even more an acre in the sections containing the most highly improved farms. In 1910 the average value was $72.73 an acre.

The geologic formations which form the surface rock in Dane County and have largely given rise to the soils are, in order of their occurrence, the Potsdam sandstone, Lower Magnesian limestone, St. Peters sandstone, and the Trenton and Galena limestone. The greater part of the county was traversed by two glacial ice sheets of different age. The older is known as the pre-Wisconsin glaciation, and its debris covers only a very small part of the county. The younger is known as the last Wisconsin glaciation, and material from this source covers over half of the county. In addition to these sources of material a mantle of loess has been deposited over most of the unglaciated section and over a part of the glaciated section.

In Dane County 13 soil series and 31 soil types, including Rough stony land, Madeland, Peat, Muck, and Meadow, are recognized.

The Carrington series consists of dark-colored, upland prairie, glaciated limestone material. Some of the highest priced farming land in the region is included in the silt loam and its shallow phase. The fine sandy loam is not important. Most of this land is cultivated. General farming is the chief activity, with tobacco growing an important special industry.

The Miami series consists of light-colored, upland, forested, glaciated limestone material. The fine sandy loam and silt loam are extensive and valuable agricultural types, the former well suited to truck crops. The silt loam and its deep phase support chiefly general farming. The gravelly sandy loam is of small extent and mostly in pasture. The loam is also inextensive, but largely in cultivation.

The Rodman gravelly fine sandy loam includes light-colored assorted glacial material which occurs chiefly as kames and eskers. It has a low agricultural value, and is of small extent.

The Fox series includes light-colored, forested soils mainly in glaciated limestone regions where the material occupies outwash plains or stream terraces. The series in this county is not extensive, but the three types encountered are well improved.

The Plainfield series is represented by one type, the fine sand. It is an alluvial terrace soil derived from glacial debris. About half the type is cultivated and used for general farming. It has a rather low value.

The Waukesha series comprises dark-colored, prairie or semi-prairie soils derived from reworked glacial material, deposited as outwash plains or terraces. It includes good agricultural land. The types mapped are Waukesha fine sandy loam and silt loam.

The Clyde series is represented by three types, the fine sandy loam, loam, and silt loam. These are dark-colored soils within the glaciated limestone region, where the material is of alluvial or lacustrine origin and occurs as old lake beds, ponded valleys, or as first-bottom land along the streams. They are low and poorly drained, but well suited to crop production when drained, especially the silt loam, which can be made very productive.

The Dunning series includes dark-colored soils of alluvial origin from which the lime has been very largely removed. The natural drainage is very poor. Dunning silt loam and fine sandy loam are recognized.

The light-colored, forested upland soils of the unglaciated region, where the material is largely of loessial origin, are classed with the Knox series. Knox silt loam is extensively developed and includes a large area of good farm land. It is mostly in cultivation to general farm crops. The steep phase is less valuable.

The Dodgeville series includes dark-colored, upland prairie soils of the unglaciated region where the material has been derived in part from the loesslike mantle covering a part of the county, and in part from the weathering of limestone. Dodgeville silt loam makes very good general farming land except where shallow. The fine sandy loam is of low agricultural value.

The Boone series includes light-colored forested soils where the material has been derived from the weathering of sandstone, in this county, chiefly the St. Peters sandstone. The series is of rather low agricultural value. The types mapped are the Boone fine sandy loam and loam.

The Wabash series comprises dark-colored soils of the unglaciated region of alluvial origin which occur as first-bottom land. Wabash loam and silt loam are recognized. For the most part the soils are poorly drained and subject to overflow. Only a small portion of the land is under cultivation.

The Genesee fine sand is a very inextensive light-colored soil which occurs as first-bottom land. The material is alluvial in origin and consists of reworked glacial debris. The land is subject to inundation.

Rough stony land comprises steep, rocky slopes where the slope is too steep or the land too rocky to be of value for cultivated crops and is of use only for pasturage and forestry.

Madeland consists of small, poorly drained areas of filled-in material.

Peat consists of vegetable matter in various stages of decomposition, with which there are usually incorporated small quantities of mineral matter. In its present condition it is poorly drained and of little value. When drained and reclaimed it makes very valuable land. Peat is an extensive type in Dane County.

Muck includes highly organic soils intermediate between Peat and soils of the Clyde series. It is not extensive in Dane County.

Meadow includes first-bottom land subject to overflow, where the material is so variable that it cannot be separated into recognized soil types. It is of very limited extent.

## KEEP THE MAP

The Experiment Station will publish bulletins from time to time dealing with the management of the different types mapped, so that some way should be found by each person receiving a copy of this report to keep the map permanently. If the map is folded in such a way as to have the part you are interested in of a convenient size, and then have a simple frame with glass to hold it, it can be kept indefinitely. Since some of the colors fade after being exposed to strong light for a long time, it would be a good plan to have a protecting flap of dark cloth over the map when not in use.

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WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

W. O. HOTCHKISS, Director and State Geologist.
A. R. WHITSON, In Charge, Division of Soils.

SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE
H. L. RUSSELL, Dean.

BULLETIN NO. 53 — SOIL SERIES NO.

# SOIL SURVEY

OF

# ROCK COUNTY

## WISCONSIN

BY

A. R. WHITSON, W. J. GEIB, GUY CONREY AND W. M. GIBBS OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, AND A. E. TAYLOR OF THE U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF SOILS.

SOIL SURVEY CONDUCTED IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF SOILS, MILTON WHITNEY, CHIEF, CURTIS F. MARBUT, IN CHARGE SOIL SURVEY.

PUBLISHED BY THE STATE
MADISON, WISCONSIN
1922

W. K. Bailey
E. H. Parker Durand
Resettlement Adm
Madison, Wis.


WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

W. O. HOTCHKISS, Director and State Geologist.
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SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE
H. L. RUSSELL, Dean.

**BULLETIN NO. 53B** **SOIL SERIES NO. 21**


# SOIL SURVEY

OF

# ROCK COUNTY

## WISCONSIN

BY


A. R. WHITSON, W. J. GEIB, GUY CONREY AND W. M. GIBBS, OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, AND A. E. TAYLOR OF THE U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF SOILS.


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SURVEY CONDUCTED IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE,
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# INTRODUCTION

Before the greatest success in agriculture can be reached, it is necessary that the farmer shou' *l* have a thorough knowledge of the soil upon his own farm. A soil may be well adapted to one crop, and poorly adapted to another crop. Clover will produce a vigorous growth and profitable yields on the average loam soil which contains lime and is in a sweet condition; but on a sandy soil which is sour, or in an acid condition, clover will not make a satisfactory growth. We may say, therefore, that failure is certain to be invited when such important facts are disregarded, or overlooked. The degree of success which it is possible to win on any farm is in direct proportion to the practical knowledge possessed by the farmer concerning the soil and its adaptation to crops. A thorough knowledge of the soil is as essential to the farmer as a knowledge of merchandise and business methods is to the merchant.

The State of Wisconsin, working in coöperation with the United States Department of Agriculture, is making a careful study of soils and agricultural conditions throughout Wisconsin, and is preparing soil maps and soil reports of all counties in the State. A soil map shows the location and extent of the different kinds of soil. Tracts of 10 acres and over are mapped, but often areas of even smaller extent are shown. The soil map is prepared by trained men, who go over a county thoroughly, and examine the soil by making a sufficient number of borings to a depth of 36 inches to keep account of all variations. A report is also made, to accompany and explain the map, and this is based upon a careful study of the soils within the region surveyed, and upon such other features as have a direct bearing upon the agriculture of the area.

It is the object of this survey to make an inventory of the soils of the State, and to be of practical help to farmers by locating and describing the different soils, by determining their physical character and chemical composition, and by offering

suggestions for their management, based upon the work of the Soil Survey within the area, covered in the report, and upon the results of field tests made by the Experiment Station.

Soil fertility depends upon two factors: first, upon the physical characteristics of the soil, such as water holding capacity, workability, etc., and second, upon the chemical composition of the material composing the soil. The chemical composition depends upon the mode of origin of the soil, and the source of material from which the soil is derived.

Water holding capacity and other physical properties of soil all depend chiefly upon *texture,* which refers to the size of the individual soil grains, or particles. A coarse sandy soil, for example, will not retain moisture so long as a loam soil, or clay loam, because the finer the soil grains, the greater will be the total soil-grain surface area to which moisture may adhere. Texture is determined in the field by rubbing the soil between the thumb and fingers, and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a *mechanical analysis,* which is made by a simple method of separating soil grains into different groups, of which there are seven. These are known as clay, silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel.

A chemical analysis is also made of the soil to determine the amounts of various essential plant-food elements which are present. A chemical analysis shows whether the soil contains a large store of plant food, or only a small quantity, and it indicates which kinds of plant food will probably be needed first. The amount of organic matter in the soil is also determined, and tests are made to show conditions relative to soil acidity.

## SOIL CLASSIFICATION.

Soils are grouped according to texture into soil classes, a soil class being made up of soils having the same texture, though differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

The textural classification is the most important since it has to do with the water holding capacity of the soil. It also determines the ease with which a soil can be worked, and has much to do with the crops to which the soil is best adapted.

### SOIL CLASSES.

#### Soils Containing Less Than 20% Silt and Clay

**Coarse sand.**—Over 25% fine gravel and coarse sand, and less than 50% of any other grade of sand.
**Sand.**—Over 25% fine gravel, coarse and medium sand, and less than 50% fine sand.
**Fine sand.**—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
**Very fine sand.**—Over 50% very fine sand.

#### Soils Containing Between 20–50% of Silt and Clay

**Sandy loam.**—Over 25% fine gravel, coarse and medium sand.
**Fine sandy loam.**—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
**Sandy clay.**—Less than 20% silt.

#### Soils Containing over 50% of Silt and Clay

**Loam.**—Less than 20% clay, and less than 50% silt.
**Silt loam.**—Less than 20% clay, and over 50% silt.
**Clay loam.**—Between 20 and 30% clay, and less than 50% silt.
**Silty clay loam.**—Between 20 and 30% clay, and over 50% silt.
**Clay.**—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a gradation in texture of otherwise uniform material, such a group is called a *soil series*. It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for example, includes light colored, glacial material where the soils have been derived largely from the underlying limestone, and the soils in the series range in texture from a clay loam to sand and gravel. The Plainfield series includes light colored soils in regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash plains or stream terraces. The soils in this series also have a wide range in texture. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil Survey. By uniting the soil class and the soil series we get the *soil type* which is the basis or unit of classifying and mapping soils. A *soil type* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural unity, that is, being adapted to the same crops, and requiring the same treatment. It is also uniform in the source of material from which it is derived, and the mode of origin which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils, and the basis upon which experimental work should be conducted, every farmer should be familiar with the soil types on his farm, and their leading characteristics.

# SOIL SURVEY OF ROCK COUNTY, WISCONSIN

## CHAPTER I.

## GENERAL DESCRIPTION AND HISTORY OF THE AREA.

### DESCRIPTION OF THE AREA.

Rock County lies in the extreme southern part of Wisconsin about midway on the Wisconsin-Illinois boundary line. Janesville, the county seat, is about 32 miles from Madison. The county has an area of approximately 706 square miles or 451,840 acres.

Fig. 1.—Sketch map of Wisconsin showing areas which have been covered by a soil survey.

The surface features of Rock County may be classed in four rather distinct divisions. The extent of each is shown in Figure No. 2. The first of these divisions is confined to the north-

ern part of the county and consists of the material which was most recently deposited by the glacial ice. It is known as the late Wisconsin drift. The southern limit of this region is marked by a low range of hills bordering an extensive level country. This range of hills is known as the "terminal moraine" and it enters the county at the northwestern corner of Union Township, extends in a southeasterly direction and passes into

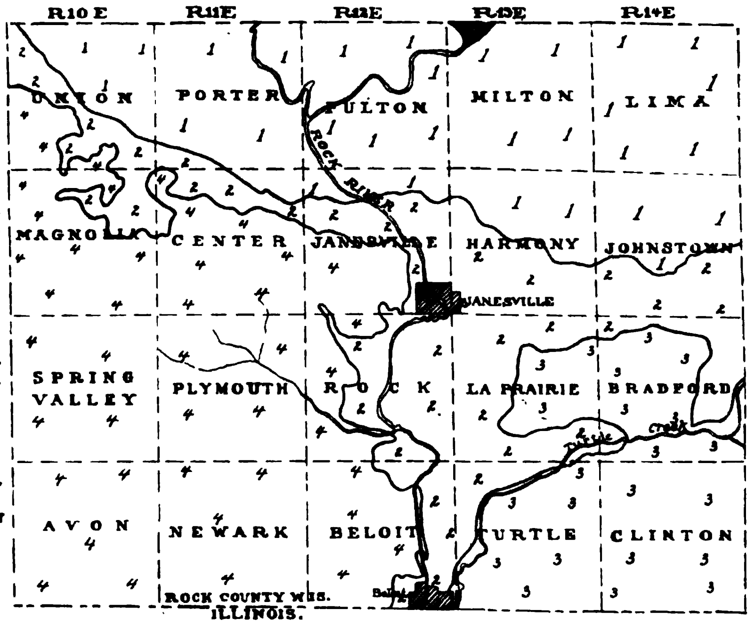


Fig. 2.—Sketch map of Rock County showing—
1. Region covered by late Wisconsin drift.
2. Level valley fill and outwash plains.
3. Region of deep pre-Wisconsin drift.
4. Region of shallow pre-Wisconsin drift.

Walworth County about one and one-half miles north of Johnston. The surface of this region to the north is for the most part gently rolling, although near the moraine it is somewhat broken by pot holes, gravel knolls, and winding ridges. In fact this whole region is now very much as it was shaped by the glacial ice, there being many kettle basins and undrained marshes. It is very interesting to note that this is the only portion of the county in which marshes occur away from streams, and stones and bowlders are also more plentiful than elsewhere.

The second division, known as the "Valley fill" or "outwash plain" is found immediately south of the late Wisconsin drift region. It is level, stone free, and is underlain by beds of sand and gravel. It extends entirely across the county from east to west, but its most extensive development is found in the towns of Johnstown, Harmony, Janesville, Rock, La Prairie, Beloit, and Turtle.

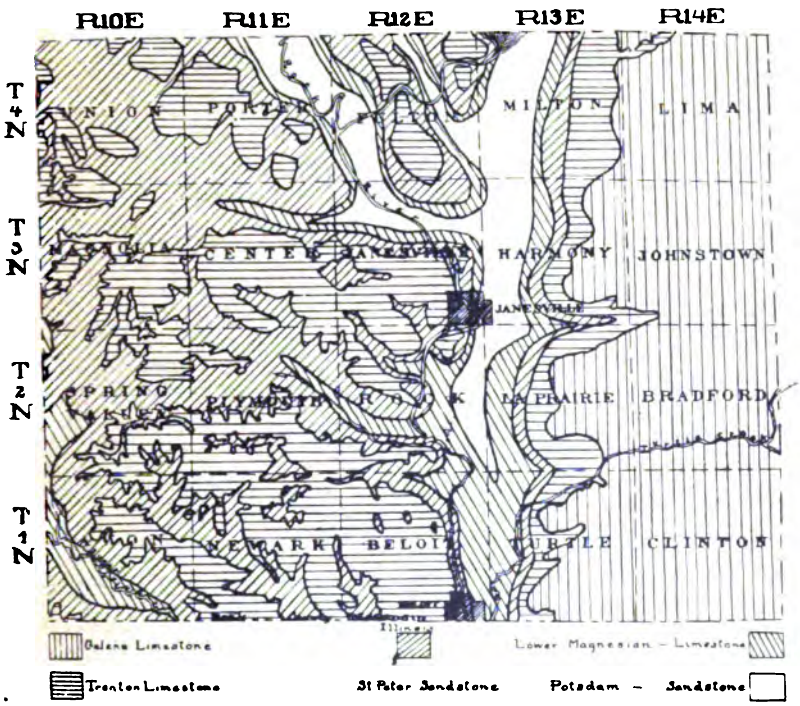


Fig. 3.—Sketch showing surface rock formations in Rock County.

The third region has a surface which is characterized by long, smooth, gentle slopes, and a soil section which is deep, in most places being over 100 feet to the bed rock. The surface is covered by a mantle of uniform silty loess-like material which is practically stone free. The region is much more thoroughly drained than the northern part of the county. This third division may be briefly described as being made up of deep, pre-Wisconsin drift material, which means that it is glacial material of much greater age than that of the late Wis-

consin drift. It is confined to the southeastern portion of the county, largely in the towns of Bradford, Clinton, and Turtle.

The fourth division occurs west of Rock River in the southwestern part of the county. This region was also gone over by the pre-Wisconsin ice sheet, but the glacial material left now forms only a very thin blanket, usually having a maximum thickness of 5 or 6 feet, and in numerous places being entirely lacking. The thin drift occurs in Magnolia, Spring Valley, and Avon Townships. Northwest of Janesville and east of Footville there is a small area over which the drift reaches a depth of from 40 to over 100 feet. The blanket of silty material common to the late Wisconsin drift, and to the older drift west of the Rock River, is seldom three feet thick and in many places entirely lacking in the southwestern portion of the county. Rock outcrops are also common throughout this region. As a rule the farming is not as highly developed in this part of the county as elsewhere, and land values average somewhat lower.

In regard to the topography of the county as a whole it may be said that the total area which is too steep for the growing of cultivated crops is very limited. Some of the land could be classed as rolling and hilly, but the major portion is gently rolling, with the equivalent of several townships in which the surface is level. The major portion of the county has an elevation of between 800 and 900 feet above sea level.

Rock County lies within the drainage basin of Rock River, which passes through the center of the county from north to south.

With the exception of Rock River, the streams are sluggish and meandering, flowing through considerable areas of poorly drained flood plains. The Rock River has cut into the old valley fill to a depth ranging from 30 to 120 feet. Outside of the valley-fill region its valley is 50 to 150 feet deep.

The first settlement in Rock County was made in 1835, on the present site of Janesville. The county was formed by an act of the Territorial Legislature of Wisconsin, on Dec. 7, 1836. The population as given in the 1920 census was 66,150, averaging 92.4 persons to the square mile.

## SOILS.

The soils of Rock County have been derived largely from glacial material of various ages, from decaying vegetable matter and from the weathering of the under-lying rock formations. In the work of the soil survey in Rock County these various soil forming materials have been classified into soil series and soil types and the location, extent and distribution has been shown on the accompanying map. In all 11 soil series and 25 soil types* have been recognized.

The Carrington series includes the dark colored upland prairie soils which have been derived largely from glaciated limestone material. Part of this series lies within the region of recent glacial drift while part of it is included in the pre-Wisconsin drift region. This series is quite extensive and the soils have a high agricultural value. The types mapped are Carrington silt loam with a shallow phase, Carrington loam, fine sandy loam and gravelly loam.

The Miami series includes the light colored upland timbered soils where the material has been derived largely from glaciated limestone. This series also includes excellent agricultural land and with the Carrington series occupies by far the The types mapped are the Clyde silt loam and fine sandy loam.

*In comparing this issue of the soil survey report of Rock County with the edition published by the United States Bureau of Soils it will be noted there is some difference in the naming of some of the soil types. In the State report the types have been correlated with the soils as previously mapped within the State while in the report issued by the United States Bureau of Soils the types have been correlated with the soils as they occur in adjoining States. The following table gives the various soils to which different names have been applied in the two reports.

| Type name in report of U. S. Bureau of Soils | Type name as published in the report issued by the State of Wisconsin |
|---|---|
| Bellefontaine gravelly loam | Miami gravelly loam |
| Bellefontaine fine sandy loam | Miami fine sandy loam |
| Bellefontaine loam | Miami loam |
| Bellefontaine silt loam | Miami silt loam |
| Miami fine sandy loam | Knox fine sandy loam |
| Miami loam | Knox loam |
| Miami silt loam | Miami silt loam, deep phase |
| Union silty clay loam | Baxter clay loam |
| Rodman gravelly sandy loam | Rodman gravelly loam |
| Waukesha gravelly sandy loam | Waukesha gravelly loam |
| Fox loam, light textured phase | Fox fine sandy loam |

greater portion of Rock County. The types mapped in the Miami series include the silt loam, with a deep phase, Miami loam, fine sandy loam and gravelly loam.

The Clyde series includes dark brown to black soils with gray, drab or mottled subsoils and the material occupies low depressed areas in the upland or old lake basins and ponded valleys in the region of alluvial soils. These soils are all relatively low lying, natural drainage is poor and there has been a considerable accumulation of organic matter in the surface soil. When drained this series makes good agricultural land.

The soils of the Knox series include the light colored upland timbered soils in the unglaciated region or where the influence of the glacial ice was very limited as in the southwestern part of Rock County. The surface of this region is mostly rolling and the natural drainage is good. This material frequently rests on weathered limestone and the underlying rock sometimes comes within three feet of the surface. The lower portion of the subsoil may in some cases have been derived from the rock itself. The types mapped as belonging to this series are the Knox loam and fine sandy loam.

The surface soil of the Crawford series includes dark to nearly black surface soils with heavy brown or reddish brown subsoils which have been derived from the underlying limestone. The rock usually comes to within from one to two feet of the surface. The surface is rolling and the drainage is good. The clay loam is the only type mapped and its extent is very limited.

The Boone series consists of light colored upland timbered soils where the parent material has been derived from sandstone. These soils occupy gently to steeply rolling uplands and the drainage is good to excessive. The only type mapped in this county belonging to this series is the Boone fine sandy loam.

The Fox series includes light brown upland timbered soils in the glaciated limestone region where the material has been derived from glaciated limestone and re-worked and re-deposited by the action of water in the form of outwashed plains, stream terraces or filled in valleys. The subsoils are usually heavy but in the lower depth grade into sand or gravel. The surface is level or nearly so and the natural drainage is for the most part

good. The types in this county belonging to the Fox series are the silt loam, loam and fine sandy loam.

The soils of the Rodman series are light brown or reddish brown in color. The subsoils are of similar color but consist of beds of loose gravel and sand. The soils consist of material which was laid down under the ice sheets by running streams and occur chiefly as sharp hills and ridges known as Kames and Eskers. The surface is very irregular; pot-holes are quite numerous and the natural drainage is excessive. This class of land is of low agricultural value. The only type mapped is the Rodman gravelly loam.

The Plainfield series consists of light brown surface soils with light brown to yellow subsoils. The surface is level and the natural drainage is somewhat excessive. The soils are all of a sandy nature and have been deposited as stream terraces or outwashed plains. Plainfield fine sand is the only type mapped in the series.

The Waukesha series consists of dark brown to black upland prairie soils where the surface is level and where the deep subsoils grade into sand and gravel. The material is largely glacial debris which has been deposited by the water as terraces, filled in valleys or outwashed plains. The Waukesha soils include some of the finest agricultural land in the region and are very highly improved. The types mapped are Waukesha silt loam with a deep phase, Waukesha loam, sandy loam, gravelly loam and sand.

The Baxter series consists of light colored upland timbered soils where the material has been derived from the underlying limestone formation. The subsoils are usually brown or reddish brown and grade into the underlying limestone at a depth of 18 inches to 3 feet. The clay loam is the only type mapped in this series.

Peat consists of large deposits of decaying vegetable matter with which there has been incorporated a small amount of mineral matter. These deposits extend to a depth of two to ten or more feet.

The material mapped as Peat has been divided into two classes: that which is over 18 inches deep is called typical Peat and that which is less than 18 inches deep has been mapped as a shallow phase of Peat.

In the following pages of this report the various soils of Rock County are described in detail and their relation to agriculture is discussed. The distribution of the soils is shown on the accompanying soil map while the table below gives the name and the actual and relative extent of each kind of soil mapped.

AREA OF DIFFERENT SOILS.

| Soil | Acres | Per cent |
|---|---|---|
| Carrington silt loam | 67,712 | 19.1 |
| Shallow phase | 19,776 | |
| Miami silt loam | 63,160 | 13.8 |
| Deep phase | 37,056 | 8.1 |
| Waukesha silt loam | 21,760 | |
| Deep phase | 41,280 | 13.7 |
| Clyde silt loam | 52,672 | 11.5 |
| Knox fine sandy loam | 24,512 | 5.3 |
| Peat | 7,040 | 2.9 |
| Shallow phase | 6,208 | |
| Miami gravelly loam | 13,184 | 2.9 |
| Waukesha loam | 12,672 | 2.9 |
| Sandy phase | 256 | |
| Fox silt loam | 12,736 | 2.8 |
| Carrington fine sandy loam | 9,728 | 2.1 |
| Miami fine sandy loam | 9,344 | 2.0 |
| Clyde fine sandy loam | 9,280 | 2.0 |
| Carrington loam | 9,088 | 1.9 |
| Baxter clay loam | 7,424 | 1.6 |
| Waukesha sandy loam | 5,888 | 1.3 |
| Fox loam | 4,864 | 1.1 |
| Boone fine sandy loam | 4,672 | 1.0 |
| Knox loam | 3,712 | .8 |
| Waukesha gravelly loam | 3,584 | .8 |
| Fox fine sandy loam | 2,496 | .5 |
| Miami loam | 2,432 | .5 |
| Waukesha sand | 2,240 | .5 |
| Carrington gravelly loam | 1,664 | .4 |
| Rodman gravelly loam | 832 | .2 |
| Plainfield fine sand | 748 | .2 |
| Crawford clay loam | 196 | .1 |
| Total | 458,240 | |

# CHAPTER II.

## GROUP OF SILT LOAM AND CLAY LOAM SOILS.

### CARRINGTON SILT LOAM.

*Extent and distribution.* Carrington silt loam with its shallow phase is the most extensive and important soil in Rock County. It is found most extensively in the southeastern part of the county in La Prairie, Bradford and Clinton Townships. Other extensive areas occur in the central part of the county extending west from Janesville, and also in the northern part of the county, between Edgerton and Evansville. In all, there are over 100 square miles of this type within the county and it occurs in every township except Lima.

*Description.* The Carrington silt loam to 12 or 14 inches consists of a dark-brown or almost black, smooth silt loam, rich in organic matter. The upper subsoil is a dingy-brown silt loam, grading downward into a yellowish-brown silt loam. The lower subsoil is a yellowish-brown silty clay loam, grading into a silty clay which continues to a depth of 3 feet or more. The entire 3-foot section is almost free from gravel, stones and bowlders and is remarkably uniform in its loess-like structure and texture. Immediately below this loess-like mantle, which varies from 3 to 8 feet in thickness, the typical glacial till consisting of clay, silt, sand and gravel is encountered. The line of separation between this and the yellowish-brown silty clay is well defined, the upper part being free from bowlders and gravel and leached free of calcium carbonate, while the till is filled with stones and bowlders and is well supplied with calcium carbonate. Both Truog and litmus tests indicate that the surface soil is in an acid condition.

As mapped, the Carrington silt loam is subject to some variations. In the northern part of the county, in the region covered by the late Wisconsin drift, and in all the occurrences of the type west of Rock River and north of the late Wisconsin terminal moraine, there are numerous inclusions of a shallow

phase of the type in which the lower subsoil is a sandy clay or silty clay carrying some gravel. When this shallow condition is of sufficient extent it has been shown on the map as a shallow phase. Where the Carrington silt loam borders the Miami silt loam, it is somewhat lighter colored and contains less organic matter. Where is borders the Clyde silt loam the lower subsoil often shows yellow and drab mottlings. When gravelly areas occur within the soil or when rock outcrops are formed, appropriate symbols have been placed on the map to show these conditions.

*Topography and drainage.* The surface of this type ranges from nearly level to gently rolling. While there are differences in elevation on the prairie of about 200 feet the slopes are long and gentle so that modern farm machinery can be operated on very nearly all of the type and only in a few places are the slopes steep enough to make erosion a serious problem. The steepest portions of the type are west of Rock River. In most places, the natural drainage is good, but on some of the more level tracts, tile drainage would be beneficial. The soil retains moisture well, and resists drought as well as any of the other soils of the county.

*Present agricultural development.* Practically all of this soil is in farms and highly improved. Corn, oats, barley and hay are the leading crops. Alfalfa and wheat are grown to some extent. Tobacco and sugar beets are special crops.

For a discussion of the chemical composition and methods for the improvement of this soil see page 26.

*Carrington silt loam, shallow phase.* The surface soil of the Carrington silt loam, shallow phase, consists of a dark-brown to almost black, friable silt loam, comparatively high in organic matter. It usually contains some fine sand, and often a small quantity of gravel. The Truog and litmus tests indicate that the surface soil is in an acid condition. The subsoil consists of a rather friable, dingy-brown silt loam grading downward into a yellowish-brown silt clay loam which carries some fine sand and gravel. At about 20 to 30 inches a sandy clay or sometimes a sandy loam, is encountered. The deep subsoil grades into typical glacial till, composed of a miscellaneous mixture of clay, sand, gravel and bowlders. In many rather large areas in the old glacial drift region, lying south of the

late Wisconsin terminal moraine and west of Rock River, where the limestone is within 4 feet of the surface, the lower subsoil is a reddish-brown clay, carrying fragments of weathered limestone, from which it has originated. In places limestone fragments occur in both soil and subsoil. Where the type borders the Miami silt loam it is lighter in color and runs lower in organic matter than elsewhere, while bordering the Miami loam or fine sandy loam or the Carrington loam or fine sandy loam both soil and subsoil contain more fine sand. On some of the steep slopes the soil has been removed by erosion and the till bed is exposed, while in other places the clay loam subsoil comes to the surface. The phase as mapped includes small areas of Carrington loam and fine sandy loam.

The Carrington silt loam, shallow phase, is extensively developed in this county. Its principal occurrence is west of Rock River in the pre-Wisconsin drift region, and between Fulton and Cooksville in the region of late Wisconsin drift. The surface varies from gently rolling to rolling. In the area of late Wisconsin drift, in the northern part of the county, the surface is in many places interrupted by Kames or Eskers and other morainic hills, and on the whole is of a morainic character while in the region of pre-Wisconsin drift, west of the Rock River, the topography is almost entirely developed by erosion. On account of the sloping surface and the open nature of the soil and subsoil, the natural drainage is good. On some of the steeper slopes, where proper care has not been taken, destructive erosion has developed.

This is an extensive and important soil in Rock County. Probably 80 per cent of it is under cultivation, the remainder being devoted to permanent pasture. General farming in conjunction with dairying is the leading type of agriculture. Like the typical Carrington silt loam, this is prairie soil, and the native growth consists almost exclusively of prairie grasses.

Corn, oats, barley, hay and tobacco are grown successfully on this soil, but yields are somewhat lower than on the typical Carrington silt loam. The soil is handled and fertilized in the same way as the typical silt loam.

Land of this phase ranges in selling value from $100 to $200 an acre, depending upon the location and improvements, depth of soil, etc., while the typical soil frequently reaches a value of $300 per acre for the best farms.

For a discussion of the chemical composition and methods for the improvement of this soil see page 26.

### WAUKESHA SILT LOAM.

*Extent and distribution.* The Waukesha silt loam with its deep phase is the most extensive and important of the alluvial soils in the county. The typical soil is much less extensive than the deep phase. The typical soil covers a total area of about twenty-five square miles. The largest areas are found northeast of Beloit, between the Rock and Turtle Rivers and immediately south of Janesville. Other smaller areas occur along the valley of Marsh Creek.

*Description.* The Waukesha silt loam to a depth of about twelve inches contains a comparatively high percentage of organic matter and some fine sand. The upper subsoil is a dark-brown silt loam, grading downward into a brownish-yellow silt loam or silty clay loam which contains a small amount of sand. At twenty-four to thirty-six inches a yellow fine sandy loam or sandy loam is encountered, quickly passing into a gravelly sandy loam and below this into stratified beds of gravel and sand. The type as mapped includes patches of Waukesha loam not sufficiently extensively to warrant separation.

*Topography and drainage.* The surface is level to very gently undulating, and the natural drainage is good. There are a few places where the underlying sand and gravel comes to within less than two feet of the surface when the soil suffers somewhat from extended dry spells.

*Waukesha silt loam, deep phase.* This is the most extensive and important of the terrace soils in Rock County. The deep phase covers a total area of about one and one-half townships. The largest area occurs in a belt from three to six miles wide, extending east from Janesville into Walworth County. This belt within the county is twelve miles long, and with adjoining soils of the Carrington series, is known as Rock Prairie. The soil of the Waukesha silt loam, deep phase, consists of a dark brown to almost black, smooth silt loam, twelve to sixteen inches deep, comparatively high in organic matter and markedly acid as shown by the Truog and litmus tests. The upper subsoil is a brown silt loam, grading into a yellowish-brown silt loam which often continues to a depth of three feet or more, but

in some places gives way to silty clay loam at about thirty inches. Both soil and subsoil are free from sand, gravel and bowlders but beds of gravel and sand occur at depths ranging from four to twelve feet, as may be seen on the sides of gullies. The deep phase has the same topographic features as the typical soil, but because of its depth and heavy nature of the subsoil, the drainage is somewhat deficient and tile drains could be installed to advantage over part of this soil. This would make possible getting on the land earlier in the spring and sooner after heavy rains.

As the silty covering over the sand and gravel is much deeper than the typical soil, and as it is free from coarse material, it has somewhat more the nature of wind blown material, and may be of loessial origin. The entire type is acid, and the acidity extends well into the subsoil.

*Present agricultural development.* The Waukesha silt loam with its deep phase averages the highest priced farm land in the country. It is practically all tillable and is all in well-improved farms. It is excellent farming land and is devoted to general farming and dairying. Corn, oats, barley and hay are the principal crops, corn occupying the largest acreage. Some wheat is also grown. Sugar beets and tobacco are special crops. This land has a selling value of from $150 to $300, depending upon the improvements, location, etc.

For a discussion of the chemical composition and the best methods for improving the soil, see page 26.

### MIAMI SILT LOAM.

*Extent and distribution.* The Miami silt loam with its deep phase is one of the most extensive types of soil in Rock County. It covers extensive areas in the northern part of the county, and there is also an extensive area in the southeastern corner. West of Afton and between Brodhead and Evansville are other important tracts. Numerous smaller patches occur throughout the county.

The typical soil is all confined to the northern part of the county.

*Description.* The typical Miami silt loam to a depth of ten or twelve inches is a light-brown silt loam, often containing a small amount of fine sand and gravel, and being low in organic

matter. Truog and litmus tests show that the soil is somewhat acid. The upper subsoil is yellowish-brown silt loam, grading at eighteen or twenty inches into a yellow silty clay loam which contains considerable fine sand and gravel. At about twenty-four inches a sandy clay, containing some gravel, is encountered, and this continues to a depth of three feet or more.

The type is subject to considerable variation, especially in the depth of the silty covering and in the content of sand and fine gravel. In depressions between gravel knolls and ridges and in level areas the silt loam is deeper than typical, while on ridges, knolls and steep slopes the soil may be washed off, the sandy clay near the surface and occasionally exposed.

*Topography and drainage.* The surface of the typical Miami silt loam is characteristic of a glacial region, and varies from gently rolling to rolling. There are numerous morainic ridges, kettle holes, drumlins, etc. Between some of the higher elevations, there are areas of gently undulating land. Because of the surface features and the open characters of the subsoil, the natural surface and under drainage are both good, yet the soil is sufficiently heavy to retain moisture well.

*Present agricultural development.* This is an important type and fully eighty per cent of it is under cultivation. General farming with dairying is the chief type of agriculture.

Corn, hay, oats and barley are the leading crops, ranking in acreage in order named. Irish potatoes, wheat, rye, beans and alfalfa are grown in a small way and tobacco, peas, and sugar beets are special crops of importance. Tobacco is grown extensively about Edgerton and to some extent over the entire type. Near Evansville a number of farmers are engaged in growing peas for canning. Sugar beets are grown in the northern part of Rock County and are shipped largely to the factory at Janesville. There are a number of home apple orchards, but the trees are largely neglected and the fruit is usually of inferior quality.

The value of land of the Miami silt loam ranges from $100 to $250 an acre, depending upon the location and improvements.

*Miami silt loam, deep phase.* The Miami silt loam, deep phase, to a depth of twelve to fourteen inches consists of a light brown, friable silt loam, low in organic matter. When dry, th material has an ashen appearance. Gravel, bowl-

VIEW OF MIAMI SILT LOAM.

Showing typical surface features of Miami silt loam as this type is found in Rock County.

SOIL SECTION—MIAMI SILT LOAM.

Showing the unassorted glacial material forming the subsoil, and the thin layer of silty, stone free material which forms the surface soil.

VIEW OF MIAMI SILT LOAM, DEEP PHASE.

Showing the smooth topography and long gentle slopes characteristic of this soil. It is confined largely to the southeastern part of Rock County, and is excellent farming land.

SOIL SECTION OF THE DEEP PHASE OF MIAMI SILT LOAM.

The point of the auger marks the point of contact between the stone free loess-like surface section, and the underlying unassorted glacial drift material which contains considerable gravel and coarse material. The loess-like covering ranges from three to six feet in thickness.

ders and fine sand are noticeably less abundant than in the typical Miami silt loam, and are frequently entirely lacking. Tests show that this soil is somewhat acid, the strongest usually being on the ridges. This acidity frequently extends to below three feet. The subsoil consists of a yellowish-brown silt loam which becomes heavier with depth, grading at about twenty-four inches into a silty clay loam which at thirty-four to thirty-six inches often shows a slight mottling of gray. Both soil and subsoil have a very smooth feel and a loess-like structure. There is a sharp line of separation between the upper silty material and the underlying glacial till, which contains stones, bowlders and gravel. The gravel consists chiefly of limestone. This till bed is found at from thirty inches to five feet. In the southeastern part of the county this very silty covering is frequently 6 to 8 feet deep.

Where this phase borders the Carrington or Clyde soils the color at the surface may range from brown to dark brown. Where it borders the typical Miami silt loam it often contains some gravel at depths of 24 to 36 inches. Some areas of typical Miami silt loam and Clyde silt loam, too small in extent to warrant separation, are included with the phase.

The Miami silt loam, deep phase, is found in all but two of the townships in the county. The largest area, however, is in the southeastern corner of the area in Turtle and Clinton Townships. The surface ranges from gently undulating to gently rolling. Drainage is good except in the more gently undulating areas, where tile drains are needed. The surface is smoother than the typical soil and long gentle slopes are quite common. The soil retains moisture very well, and crops suffer less during long, dry periods than on most of the other soils of the county. The phase is not subject to destructive erosion.

This is one of the more productive soils of the county and about 90 per cent of it is under cultivation. General farming in connection with dairying is the leading type of agriculture. The small woodlots support a growth of bur oak, black oak, red oak, maple, elm, hickory and cherry. The same crops are grown as on the typical soil, and the farming methods are similar. Yields are slightly higher, and the selling price shows some difference, ranging from $150 to $250 an acre.

For a discussion of the chemical composition and methods for the improvement of this soil, see page 26.

### FOX SILT LOAM.

*Extent and distribution.* This type occurs in comparatively large areas several miles north of Johnstown Center, west of Milton Junction and north of Janesville along Rock River. Small areas are found in almost all parts of the country.

*Description.* The Fox silt loam to a depth of ten to twelve inches, consists of a light-brown or grayish-brown, friable silt loam which has a whitish appearance when dry, owing to its very low content of organic matter. The material is almost free from sand and gravel, and has an extremely smooth feel. The upper subsoil is brownish-yellow silt loam, grading at sixteen to twenty inches into a yellow silty clay loam which may continue to a depth of three feet or more. In many places a silty fine sandy loam is encountered at any depth from twenty-two to thirty-six inches. It is underlain by stratified beds of sand or gravel.

*Topography and drainage.* The surface is level to very gently undulating, and the natural drainage is sufficient except where the underlying beds of sand and gravel are three feet or more below the surface. Bordering Clyde areas, the drainage is also frequently deficient.

*Native vegetation.* The original timber growth consisted of oak, elm, hickory and some ash and elm.

*Present agricultural development.* Corn, oats, barley, clover and timothy hay are the most important crops. Irish potatoes, sugar beets and tobacco are grown rather extensively in some sections. Very nearly all of this land is cleared and included in highly improved farms.

Land of the Fox silt loam has a selling value of $120 to $200 an acre, according to the location and state of improvements.

The methods suggested for the improvement of Miami silt loam will apply equally well to the Fox silt loam.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF UPLAND SILT LOAM SOILS IN ROCK COUNTY.

These soils are very similar in the texture, and structure of the surface and the upper portion of the subsoil section. They differ chiefly in color. The Waukesha and Carrington silt loams are dark colored prairie soils, and both are high in or-

ganic matter and nitrogen. Miami and Fox silt loams are light colored and are timbered soils low in organic matter. The types are so closely related that with few exceptions methods for the improvement of one will apply to the others.

The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most apt to be deficient are nitrogen, phosphorus, potassium and lime or calcium. He should know the part which each plays in the development of the plant, and what are the best methods of maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years, and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A 5 ton crop of alfalfa requires 185 pounds of lime and 2 tons of red clover removes 61.6 pounds. A much larger amount is removed by leaching each year and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Tests show that the subsoil, especially of the deep phase of Miami silt loam is frequently deficient in lime to a depth of thirty-two inches or more. The deficiency frequently extends down to where fine gravel and coarse sand is found in the subsoil.

While it will be seen from tests that by far the greater part of this land shows some degrees of acidity it does not mean that all of the land is in immediate need of lime. Where such crops as alfalfa, sugar beets, tobacco, peas, cabbage and other garden crops are grown and where the acidity is medium from 2 to 3 tons per acre of ground limestone may be used with profit. Where a liberal supply of manure is available the need for lime will not be so great. The second application which may be needed after 4 or 5 years will be less than the first.

Where such crops as corn, clover and oats are grown with manure once during each rotation a smaller amount of lime will be needed. On parts of the farm where manure cannot be applied the lime can be used with profit on such soils and may be actually necessary for economic production. The greater need will usually be on the higher places, rather than on the lower slopes.

### FOX SILT LOAM.

*Extent and distribution.* This type occurs in comparatively large areas several miles north of Johnstown Center, west of Milton Junction and north of Janesville along Rock River. Small areas are found in almost all parts of the country.

*Description.* The Fox silt loam to a depth of ten to twelve inches, consists of a light-brown or grayish-brown, friable silt loam which has a whitish appearance when dry, owing to its very low content of organic matter. The material is almost free from sand and gravel, and has an extremely smooth feel. The upper subsoil is brownish-yellow silt loam, grading at sixteen to twenty inches into a yellow silty clay loam which may continue to a depth of three feet or more. In many places a silty fine sandy loam is encountered at any depth from twenty-two to thirty-six inches. It is underlain by stratified beds of sand or gravel.

*Topography and drainage.* The surface is level to very gently undulating, and the natural drainage is sufficient except where the underlying beds of sand and gravel are three feet or more below the surface. Bordering Clyde areas, the drainage is also frequently deficient.

*Native vegetation.* The original timber growth consisted of oak, elm, hickory and some ash and elm.

*Present agricultural development.* Corn, oats, barley, clover and timothy hay are the most important crops. Irish potatoes, sugar beets and tobacco are grown rather extensively in some sections. Very nearly all of this land is cleared and included in highly improved farms.

Land of the Fox silt loam has a selling value of $120 to $200 an acre, according to the location and state of improvements.

The methods suggested for the improvement of Miami silt loam will apply equally well to the Fox silt loam.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF UPLAND SILT LOAM SOILS IN ROCK COUNTY.

These soils are very similar in the texture, and structure of the surface and the upper portion of the subsoil section. They differ chiefly in color. The Waukesha and Carrington silt loams are dark colored prairie soils, and both are high in or-

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The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most apt to be deficient are nitrogen, phosphorus, potassium and lime or calcium. He should know the part which each plays in the development of the plant, and what are the best methods of maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years, and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A 5 ton crop of alfalfa requires 185 pounds of lime and 2 tons of red clover removes 61.6 pounds. A much larger amount is removed by leaching each year and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Tests show that the subsoil, especially of the deep phase of Miami silt loam is frequently deficient in lime to a depth of thirty-two inches or more. The deficiency frequently extends down to where fine gravel and coarse sand is found in the subsoil.

While it will be seen from tests that by far the greater part of this land shows some degrees of acidity it does not mean that all of the land is in immediate need of lime. Where such crops as alfalfa, sugar beets, tobacco, peas, cabbage and other garden crops are grown and where the acidity is medium from 2 to 3 tons per acre of ground limestone may be used with profit. Where a liberal supply of manure is available the need for lime will not be so great. The second application which may be needed after 4 or 5 years will be less than the first.

Where such crops as corn, clover and oats are grown with manure once during each rotation a smaller amount of lime will be needed. On parts of the farm where manure cannot be applied the lime can be used with profit on such soils and may be actually necessary for economic production. The greater need will usually be on the higher places, rather than on the lower slopes.

### FOX SILT LOAM.

*Extent and distribution.* This type occurs in comparatively large areas several miles north of Johnstown Center, west of Milton Junction and north of Janesville along Rock River. Small areas are found in almost all parts of the country.

*Description.* The Fox silt loam to a depth of ten to twelve inches, consists of a light-brown or grayish-brown, friable silt loam which has a whitish appearance when dry, owing to its very low content of organic matter. The material is almost free from sand and gravel, and has an extremely smooth feel. The upper subsoil is brownish-yellow silt loam, grading at sixteen to twenty inches into a yellow silty clay loam which may continue to a depth of three feet or more. In many places a silty fine sandy loam is encountered at any depth from twenty-two to thirty-six inches. It is underlain by stratified beds of sand or gravel.

*Topography and drainage.* The surface is level to very gently undulating, and the natural drainage is sufficient except where the underlying beds of sand and gravel are three feet or more below the surface. Bordering Clyde areas, the drainage is also frequently deficient.

*Native vegetation.* The original timber growth consisted of oak, elm, hickory and some ash and elm.

*Present agricultural development.* Corn, oats, barley, clover and timothy hay are the most important crops. Irish potatoes, sugar beets and tobacco are grown rather extensively in some sections. Very nearly all of this land is cleared and included in highly improved farms.

Land of the Fox silt loam has a selling value of $120 to $200 an acre, according to the location and state of improvements.

The methods suggested for the improvement of Miami silt loam will apply equally well to the Fox silt loam.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF UPLAND SILT LOAM SOILS IN ROCK COUNTY.

These soils are very similar in the texture, and structure of the surface and the upper portion of the subsoil section. They differ chiefly in color. The Waukesha and Carrington silt loams are dark colored prairie soils, and both are high in or-

ganic matter and nitrogen. Miami and Fox silt loams are light colored and are timbered soils low in organic matter. The types are so closely related that with few exceptions methods for the improvement of one will apply to the others.

The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most apt to be deficient are nitrogen, phosphorus, potassium and lime or calcium. He should know the part which each plays in the development of the plant, and what are the best methods of maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years, and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A 5 ton crop of alfalfa requires 185 pounds of lime and 2 tons of red clover removes 61.6 pounds. A much larger amount is removed by leaching each year and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Tests show that the subsoil, especially of the deep phase of Miami silt loam is frequently deficient in lime to a depth of thirty-two inches or more. The deficiency frequently extends down to where fine gravel and coarse sand is found in the subsoil.

While it will be seen from tests that by far the greater part of this land shows some degrees of acidity it does not mean that all of the land is in immediate need of lime. Where such crops as alfalfa, sugar beets, tobacco, peas, cabbage and other garden crops are grown and where the acidity is medium from 2 to 3 tons per acre of ground limestone may be used with profit. Where a liberal supply of manure is available the need for lime will not be so great. The second application which may be needed after 4 or 5 years will be less than the first.

Where such crops as corn, clover and oats are grown with manure once during each rotation a smaller amount of lime will be needed. On parts of the farm where manure cannot be applied the lime can be used with profit on such soils and may be actually necessary for economic production. The greater need will usually be on the higher places, rather than on the lower slopes.

## FOX SILT LOAM.

*Extent and distribution.* This type occurs in comparatively large areas several miles north of Johnstown Center, west of Milton Junction and north of Janesville along Rock River. Small areas are found in almost all parts of the country.

*Description.* The Fox silt loam to a depth of ten to twelve inches, consists of a light-brown or grayish-brown, friable silt loam which has a whitish appearance when dry, owing to its very low content of organic matter. The material is almost free from sand and gravel, and has an extremely smooth feel. The upper subsoil is brownish-yellow silt loam, grading at sixteen to twenty inches into a yellow silty clay loam which may continue to a depth of three feet or more. In many places a silty fine sandy loam is encountered at any depth from twenty-two to thirty-six inches. It is underlain by stratified beds of sand or gravel.

*Topography and drainage.* The surface is level to very gently undulating, and the natural drainage is sufficient except where the underlying beds of sand and gravel are three feet or more below the surface. Bordering Clyde areas, the drainage is also frequently deficient.

*Native vegetation.* The original timber growth consisted of oak, elm, hickory and some ash and elm.

*Present agricultural development.* Corn, oats, barley, clover and timothy hay are the most important crops. Irish potatoes, sugar beets and tobacco are grown rather extensively in some sections. Very nearly all of this land is cleared and included in highly improved farms.

Land of the Fox silt loam has a selling value of $120 to $200 an acre, according to the location and state of improvements.

The methods suggested for the improvement of Miami silt loam will apply equally well to the Fox silt loam.

## CHEMICAL COMPOSITION AND IMPROVEMENT OF UPLAND SILT LOAM SOILS IN ROCK COUNTY.

These soils are very similar in the texture, and structure of the surface and the upper portion of the subsoil section. They differ chiefly in color. The Waukesha and Carrington silt loams are dark colored prairie soils, and both are high in or-

ganic matter and nitrogen. Miami and Fox silt loams are light colored and are timbered soils low in organic matter. The types are so closely related that with few exceptions methods for the improvement of one will apply to the others.

The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most apt to be deficient are nitrogen, phosphorus, potassium and lime or calcium. He should know the part which each plays in the development of the plant, and what are the best methods of maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years, and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A 5 ton crop of alfalfa requires 185 pounds of lime and 2 tons of red clover removes 61.6 pounds. A much larger amount is removed by leaching each year and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Tests show that the subsoil, especially of the deep phase of Miami silt loam is frequently deficient in lime to a depth of thirty-two inches or more. The deficiency frequently extends down to where fine gravel and coarse sand is found in the subsoil.

While it will be seen from tests that by far the greater part of this land shows some degrees of acidity it does not mean that all of the land is in immediate need of lime. Where such crops as alfalfa, sugar beets, tobacco, peas, cabbage and other garden crops are grown and where the acidity is medium from 2 to 3 tons per acre of ground limestone may be used with profit. Where a liberal supply of manure is available the need for lime will not be so great. The second application which may be needed after 4 or 5 years will be less than the first.

Where such crops as corn, clover and oats are grown with manure once during each rotation a smaller amount of lime will be needed. On parts of the farm where manure cannot be applied the lime can be used with profit on such soils and may be actually necessary for economic production. The greater need will usually be on the higher places, rather than on the lower slopes.

It has been quite definitely established that the need for lime in these soils runs practically parallel with the need of phosphorus. The use of lime alone will not make enough phosphorus available, and the use of a phosphate fertilizer will not supply the lime requirements of the soil. Either lime alone or acid phosphate alone will give increased yields, but neither alone will give as great an increase nor as profitable an increase as when both are supplied. In the improvement of these lands, therefore, provision for the use of both lime and a phosphate fertilizer should be made.

Phosphorus exists in all soils in Wisconsin in small amounts. Many of the best types in the state contain only 1,200 pounds to the acre eight inches deep, and this is in a form which becomes available to crops very slowly. Phosphorus is constantly being lost from the farm in crops, milk and in the bones of animals sold. It is well understood that when grain, hay, potatoes or other cash crops are sold, this element is removed from the farm. This element cannot be supplied from the air and in the long run the loss must be made up through additions of phosphorus fertilizer in some form.

Ten samples of Waukesha silt loam gave an average of 1,408 pounds per acre. In 16 samples of Miami silt loam the average amount of phosphorus present was 1,057 pounds per acre. The lowest amount found in any of the samples was 800 pounds per acre. The number of pounds of phosphorus in the soil, however, cannot be taken to indicate the immediate need for phosphate fertilizer. The system of farming followed, crops grown, type of soil and conditions relative to acidity are all important factors in determining the need for phosphorus. It should also be borne in mind that where soils are acid the amount of phosphorus which they do contain is not so readily available to plants as in soils which are not acid.

On good upland soil where dairying or general farming is practiced the use of 200 pounds of 16 per cent acid phosphate or 75 pounds of 44 per cent super-phosphate to the acre every four or five years will maintain the phosphorus supply. If much grain, potatoes or other crops are sold, more phosphate should be used.

On the farm of Roy Marshall at Elkhorn in Walworth County an application of one hundred pounds per acre

of treble superphosphate (44 per cent) on corn gave a yield of 15,570 pounds of silage while on the untreated plot the yield was 13,335 pounds per acre. In a test on the Station Farm at Madison, on the Miami silt loam soil a phosphate fertilizer applied at the rate of two hundred pounds per acre on oats gave a yield of 93.8 bushels while the untreated yield was 70.4 bushels. This was on land where the fertility was quite high. In another case where 500 lbs. of 16 per cent acid phosphate per acre was applied to prairie land which received both manure and limestone the yield of alfalfa was nearly doubled. In some of these cases the increase is small but it should be kept in mind that the fertilizer left over in the soil will be of considerably value to the following crop, especially clover.

On soils relatively low in fertility somewhat more phosphate should be used at first. This is especially true of the dark prairie soils which have grown corn or small grain a long time without the use of manure or other fertilizer.

If considerable amounts of bran or cottonseed meal are fed, which are relatively high in phosphorus, the supply of this element may be maintained. It would usually be necessary to feed at least one-half ton of bran or cottonseed meal to each cow on a dairy farm per year to maintain the phosphorus supply of the soil. Since comparatively few farmers do that some phosphate fertilizer should be used.

Potassium exists in these soils in large amounts, but in relatively unavailable form. Chemical analyses show that they often contain from 30,000 to 40,000 pounds an acre eight inches, while these same soils will contain only one-eighteenth as much phosphorus. On most soils of fairly heavy texture, when live stock is maintained, and the manure carefully used so there is considerable actively decomposing organic matter in the soil, a sufficient amount of potassium will become available from year to year to supply the needs of general farm crops. There are some crops that need relatively large amounts of potassium such as potatoes, tobacco and cabbage and they will often be benefited by some addition of potash in the form of commercial fertilizer.

Nitrogen is chiefly responsible for the dark green, healthy color and rapid growth of corn or other crops on well manured

land. It is important to have sufficient amounts in the soil, but when in excess it is detrimental for some crops. The quality of the grain may be injured by too much nitrogen. When the grain lodges the kernels do not fully mature.

Virgin soils contain large amounts of nitrogen but if they are cropped continuously to such crops as corn, oats and timothy without the addition of fertilizer material containing nitrogen the nitrogen supply is gradually exhausted and the yields are reduced.

The supply of organic matter and nitrogen in the prairie soils is considerably higher than in the light colored timber soils. Eight soils tested from the Waukesha silt loam contained an average of 4,500 pounds of nitrogen in the surface eight inches per acre. Carrington silt loam will average about the same. This amount is considered a very good supply. A question of importance in connection with the nitrogen of this soil, however, is its availability to plants, and in the soils which have been under cultivation for a long number of years, this nitrogen is somewhat inert, and when in this condition, decaying vegetable matter, green crops, or manure plowed under will give a more readily available supply of nitrogen.

The clover, alfalfa, peas and beans have bacteria on their roots that take the free nitrogen from the air and store it in the plant roots. This is the cheapest method of obtaining nitrogen and one which the farmers should use to the fullest extent. On the ordinary dairy farm at least one-fourth of the land under cultivation should be seeded to clover or alfalfa. This should be fed to stock or plowed under as green manure to insure keeping up the supply of nitrogen and organic matter.

A rotation with a legume plowed under will secure nitrogen and reduce danger from diseases, and when supplemented with phosphorus and potassium fertilizers the legumes thus treated will take the place of manure, which can then be used for other crops on the farm.

Certain crops such as tobacco, potatoes and vegetables are grown by farmers who do not keep much livestock and who do not rotate these crops with legumes. This is not a good practice.

### CRAWFORD CLAY LOAM.

The Crawford clay loam consists of a blackish clay loam, clay, or sandy clay, passing at about 8 inches into a heavy dark reddish brown clay, which at 12 inches grades into weathered limestone from which the soil has been derived. Angular fragments of limestone and chert are scattered over the surface and mixed through the soil section in sufficient quantities to hinder or even prevent cultivation.

This type is confined to a few small areas along ridges and steep hillsides southwest of Orfordville. The total area will not exceed one square mile. The surface drainage is usually good.

Because of its small extent and the closeness of the limestone to the surface, the type is difficult to cultivate and it is unimportant in the agriculture of Rock County. Probably 75 per cent of it is under cultivation. Corn, oats and hay are grown, and give fair yields.

The incorporation of vegetable matter will improve the texture of this soil and make it easier to cultivate. The steep slopes should be kept in permanent pasture, on account of washing.

### BAXTER CLAY LOAM.

This type is not extensive. It is found only in the western part of the county in Magnolia, Spring Valley, and Avon townships with a few scattered areas in Newark township. The total area is less than ten square miles.

The surface soil of the Baxter clay loam is a light brown to brown silt loam to silty clay loam, containing a small amount of organic matter. At eight to eleven inches a reddish-yellow clay is encountered, grading at sixteen to thirty inches into the weathered limestone. Irregular limestone and chert fragments are often scattered over the surface, and are present in both soil and subsoil. On steep slopes the reddish-brown clay is often exposed at the surface. As mapped, this type includes many small areas of loam and silt loam. The loam variation consists of a light-brown loam, low in organic matter, underlain at eight to twelve inches by a reddish-brown, sandy clay loam, or sandy clay, which grades at sixteen to twenty-four inches into the weathered limestone. Limestone and chert fragments are often

present in both soil and subsoil, and are scattered over the surface. On the steep slopes where erosion has been active there are many exposures of reddish-brown clay. The loam is inextensive. It occurs in Spring Valley township, the western part of Newark township, and the northern part of Avon township. The surface is rolling or steep, and the surface drainage is good. Practically the same crops are grown, and the same yields are obtained as on the clay loam.

The surface is rolling to hilly. The type occupies steep slopes and sharp narrow ridges where erosion is serious, having developed numerous deep gullies and ravines. Because of the uneven surface features, the natural surface drainage is good.

The original timber growth consisted of several varieties of oak, maple, poplar, hickory and some basswood. Most of the merchantable timber has been cut.

Probably twenty-five per cent of this soil is cultivated; the remainder is used largely as permanent pasture. The heavy character of this soil and the rolling surface makes cultivation difficult. Methods for improvement of Miami silt loam will apply fairly well to this soil.

# CHAPTER III.

## GROUP OF LOAMS AND FINE SANDY LOAMS.

### KNOX LOAM.

Knox loam is of limited extent and of minor importance in Rock County. It occurs only in small patches and is found chiefly in Newark, Avon, Valley and Plymouth Townships. The largest area covers less than one square mile.

The surface is a light brown loam with only a moderate amount of organic matter. This extends to about 8 to 10 inches where the material is usually lighter in color. A yellowish-brown sticky sandy loam or light clay loam is found at 14 to 18 inches, and this frequently becomes heavier with depth. It frequently grades into reddish-brown, heavy gritty material at about 2 feet and then rests upon limestone at 30 to 36 inches. In other places the subsoil is more sandy and the rock is not reached in the 3-foot section. In a few places the bed rock was found within 2 feet of the surface, but in most instances it was below 3 feet.

The surface is gently rolling, and the natural drainage is good. But little damage has been caused by erosion, but on the steeper slopes there is some danger of washing when fields are not covered by a growing crop.

This soil is all found within the region covered by the pre-Wisconsin ice-sheet, and a large part of it has been derived from the old glacial material. This glacial deposit, however, is thin, and in numerous places the subsoil has been derived from the weathering of underlying limestone. Some of the fine particles may be of wind blown or loessial origin. While coming in part from limestone material, the surface soil is usually at least slightly acid.

The native timber was hardwood, consisting of hickory, oak, maple, with some walnut.

This soil is mostly under cultivation and devoted to the general farm crops of this region. In crop yields and general pro-

ductiveness, and methods of farming practiced upon it, this soil is very similar to the Knox fine sandy loam.

For methods of improvement and chemical analyses of this soil, see page 44.

### MIAMI LOAM.

The Miami loam is of very limited extent, and is confined to a few scattered areas in Porter, Milton, and Lima townships. The largest area of about one square mile is located about four miles northeast of Milton Junction. The total amount of this type in the county does not exceed two square miles.

The surface soil is a light brown loam to a depth of 8 to 11 inches, underlain by a yellowish-brown loam, grading at fourteen inches into a sandy clay loam, which becomes a reddish-yellow sandy clay, extending to a depth of over three feet. Fine gravel stores are frequently found in the subsoil, and some may also appear upon the surface. The type is quite variable, and includes patches of silt loam and fine sandy loam. The surface is gently rolling, and the natural drainage is good.

Most of the lime carbonate has been leached from the surface soil, and varying degrees of acidity have developed.

Practically all of the native timber has been removed, and most of the type has been placed under cultivation.

It is well suited to all general farm crops grown in this region. Because of its limited extent, few, if any, farms are located entirely upon it, and no methods peculiar to this soil have been devised. In the methods followed and yields obtained, this soil is very similar to the Miami fine sandy loam, which is found in much larger areas in Rock County.

For methods of improvement and for the chemical composition of this soil, see page 44.

### FOX LOAM.

*Extent and distribution.* The Fox loam is well distributed in small areas throughout the western part of the county, with only a few areas east of Rock River in Turtle Township. The largest area occurs southeast of Evansville.

*Description.* The Fox loam consists of a brown loam, passing at about 10 inches into a heavy, yellowish brown loam or light sandy clay loam, which grades downward into a yellow-

brown or brownish-yellow gravelly sandy clay. At about 30 inches stratified beds of yellow gravel and sand are encountered. Litmus paper tests show that the surface soil is acid. In some places the beds of gravel and sand are within 20 inches of the surface, while in others they do not occur within the 3 foot section. Southeast of Evansville the surface soil is somewhat darker than typical, and the subsoil shows more or less mottling with yellow, brown and drab. There are some included areas, too small to map, of Fox silt loam and fine sandy loam and Clyde loam and fine sandy loam.

Small areas of a fine sandy loam variation are included with this type. The variation consists of about 10 inches of light-brown to brown fine sandy loam, underlain by pale-yellow sandy loam which extends to 12 or 14 inches, becoming heavier with depth. The pale yellow subsoil ranges from a heavy fine sandy loam to a sandy clay. In some places it extends to a depth of more than 3 feet, while in others a bed of stratified medium and fine sand or gravel is encountered at depths of 2 to 3 feet. This soil has a total area of less than 2 square miles, but is rather widely distributed over that part of the county west of Rock River.

*Topography and drainage.* The topography ranges from almost level to gently sloping or gently undulating, and the natural drainage is usually good except in the areas southeast of Evansville where artificial drainage would be beneficial. The soil is open and porous, and readily absorbs the normal rainfall.

*Present agricultural development.* Nearly all of this type is under cultivation, and is devoted chiefly to corn, oats, barley, rye, and hay. The methods of cultivation followed and yields secured are the same as on the Fox silt loam. The type is easy to cultivate, and a mellow seed bed can be readily obtained. The soil is deficient in organic matter, and is somewhat acid.

Methods of the improvement of this soil are discussed on page 44 of this report.

FOX FINE SANDY LOAM.

This soil, to a depth of about ten inches, consists of a loamy brown sand, underlain by a brownish-yellow loamy sand which at about 14 inches grades into yellow sandy loam, the latter continuing to a depth of more than 36 inches. There is usually some

gravel in the lower subsoil. In places the surface soil is a brown sandy loam, passing at about 10 inches into a yellow sandy clay loam which grades downward into a yellow sandy loam. In some places beds of gravel and sand are encountered within the 3-foot section.

The soil is found on the lower terraces along Rock River, on the higher terraces along Sugar River and Bass Creek, and on the outwash plain south of Evansville. The surface is level to gently undulating but drainage is well established.

In addition to the regular farm crops extensively grown in the region some buckwheat and Irish potatoes are also grown. The methods of cultivation and fertilization on this phase are essentially the same as on Miami fine sandy loam.

For a discussion of the chemical composition and methods for the improvement of this soil, see page 44.

### KNOX FINE SANDY LOAM.

*Extent and distribution.* This soil is confined to the southwestern quarter of Rock County where it is quite generally distributed. It makes up fully half of Newark Township and a smaller proportion of adjoining townships.

*Description.* The surface soil to a depth of eight to ten inches consists of a light brown fine sandy loam containing a small amount of organic matter. It is underlain by a brownish-yellow fine sandy loam which usually grades into a sandy clay loam at from eighteen to twenty-four inches. This usually continues to a depth of three feet or more. The soil section is quite variable and in places the lower portion is more sandy than indicated above. In other places, the underlying rock may come within the three foot section, and this is overlain by a heavy reddish-brown clay. Rock outcrops are quite common, and over limited areas, all depths of soil over rock from a few inches to three feet are to be found.

*Topography and drainage.* The surface of most of this type is rolling with some areas which are only undulating to gently rolling. The natural drainage is good, and over the most sandy places it is inclined to be excessive. Erosion is a factor to be considered in farming this soil, and some damage has resulted to the steeper slopes from washing.

The greater part of the surface soil shows varying degrees

of acidity, the strongest acidity usually being where the soil section is the deepest.

*Native vegetation.* The native timber consisted largely of oak, hickory, and maple. Practically all of the merchantable timber has been removed, and the land placed under cultivation.

*Present agricultural development.* Approximately 80 per cent of this type is being farmed. It is an easy soil to cultivate; it warms up quickly in the spring, is well drained, and responds readily to fertilization. On the other hand, it is deficient in organic matter, has a rather limited supply of the mineral plant food elements and is not as retentive of moisture as the heavier soils. Average yields are lower than Knox or Miami silt loam. The chief crops grown are corn, clover and timothy for hay, rye, barley, potatoes, some tobacco, buckwheat, and a limited amount of alfalfa. A few apple orchards were seen, but fruit is not raised on a commercial scale.

Methods for the improvement of this soil are discussed on page 44.

### MIAMI FINE SANDY LOAM.

*Extent and distribution.* This soil is confined to the northern part of Rock County, and the largest area occurs between Lake Koshkonong and the northeastern corner of the county, where it joins a larger tract in Jefferson County. A few other small patches occur scattered about the northern part of the area. In all, there are about twelve square miles of this soil.

*Description.* The Miami fine sandy loam consists of a light-brown fine sandy loam, low in organic matter, and usually in an acid condition, underlain at eight to ten inches by a brownish-yellow or yellow fine sandy loam, which gradually becomes heavier until a sandy clay loam or sandy clay is encountered at fifteen to twenty-four inches. This continues to a depth of three feet or more.

The type as mapped is not uniform. In numerous small areas, mainly along ridge crests or on steep slopes where erosion has carried away the surface soil, the fine sandy loam extends to a depth of only a few inches, and rests on yellowish sandy clay, while at the base of slopes, where washed-down materials have been deposited, the light-brown sandy layer extends to depth of ten to twenty inches, passing into yellow fine

sandy loam which sometimes continues to a depth of three feet, but usually gives way to a yellowish sandy clay in the lower part of the three foot section.

*Topography and drainage.* The surface ranges from gently rolling to rolling, and the natural drainage is good, frequently excessive in the most sandy places. On some of the steeper slopes erosion becomes a problem, and the surface has in places been washed away.

*Present agricultural development.* Fully 75 per cent of this soil is cleared and under cultivation, and this type has many points in its favor. It is well drained, works easily, warms up quickly in the spring and responds quickly to fertilization. Yields, however, do not average so high as on the loam and silt loam types, due to a lower water holding capacity and a somewhat smaller total supply of mineral plant food.

The crops grown are corn, clover and timothy, rye, barley, tobacco, potatoes, buckwheat, alfalfa, beans, wheat, and melons. There are a few apple orchards, but the industry is not developed on a commercial scale. Fruit is usually inferior in quality partly because but little spraying is done.

While stable manure is the chief fertilizer applied, the use of commercial fertilizers has been started, and phosphate fertilizers especially have given good results. Some liming has also been done with good results.

The lack of sufficient fertilization, crop rotations, etc., has caused a decrease in the productiveness of numerous farms on this soil, but this condition can be improved by following methods for the improvement of this soil as outlined on page 44.

### BOONE FINE SANDY LOAM.

*Extent and distribution.* The Boone fine sandy loam occurs largely on slopes below outcrops of the St. Peters sandstone in the extreme western part of the county, in Newark, Avon, Spring Valley, and Magnolia Townships. The total area amounts to less than eight square miles.

*Description.* The Boone fine sandy loam to an average depth of eight to ten inches, consists of a light-brown to brown fine sand or fine sandy loam, very low in organic matter and in an acid condition. The subsoil is yellow fine sandy loam which becomes heavier with depth and gives way at twenty to twenty-

four inches to a yellow sandy clay, the latter continuing to a depth of three feet or more. Fragments of sandstone are sometimes present in both soil and subsoil. In some places especially near the base of slopes, the surface soil is a light brown or brown fine sand passing at about ten inches into a yellow fine sand, which may continue to twenty-four to thirty inches before a yellow fine sandy loam is encountered. On the slopes, immediately below sandstone outcrops, irregular fragments of sandstone are scattered over the surface and mixed throughout the soil in sufficient quantities to hinder cultivation.

A sandy phase of this type occurs in Sections 30, 31 and 32, Newark Township, and Section 36, Avon Township. Both soil and subsoil are more sandy than typical, and only in a few places was sticky material found in the subsoil. In a few places, small sand dunes have been formed by the wind. This sandy area would have been mapped as Boone fine sand had it been of sufficient extent.

*Topography and drainage.* The surface varies from gently sloping to steep and drainage is always sufficient and often excessive. On the steep slopes there is considerable damage from washing, deep gullies having developed in a number of places.

*Present agricultural development.* About 30 per cent of the type is cultivated, and the remainder is in timber and permanent pasture. In the early season when there is plenty of moisture the pasture is fair, but later in summer during dry weather, the grasses dry up and pasture is poor. Corn, oats, rye, buckwheat and some hay are grown but average yields are rather low. The soil is deficient in organic matter, and also in the mineral plant food elements, and requires special treatment to secure best results. Methods suggested for its improvement are given on page 44.

Farms on this land have a selling value of $50.00 to $75.00, depending upon amount of clearing, the topography, location, and improvements.

## WAUKESHA LOAM.

*Extent and distribution.* This type covers a total area of a little more than half a township and is one of the important prairie types of soil in Rock County. It is found chiefly in La

Prairie and Rock Townships. Smaller tracts occur east of Leyden in Janesville Township and along both sides of Rock River just north of Beloit. Smaller patches occur near Evansville and at intervals along Turtle River.

*Description.* The soil of the Waukesha loam consists of a dark-brown to black loam, high in organic matter, underlain at 10 to 12 inches by a dark-brown sandy clay loam which takes on a dingy-brown color at about 18 inches and passes at 30 inches into a bed of gravelly sand which continues to a depth of 3 feet or more.

As mapped this type is somewhat variable. The surface soil of included areas ranges from almost a sandy loam to a silt loam. The subsoil may be a sandy loam, passing into beds of sand or gravel at 12 or 15 inches, or it may be a dark-brown loam or heavy sandy loam to a depth of 3 feet or more. In La Prairie and Rock Townships much of the type is heavier approaching a silt loam, and patches of Waukesha silt loam are included. In places these inclusions are so numerous that it is difficult to determine whether the loam or silt loam is the predominating type.

*Topography and drainage.* The surface of this soil is level to gently undulating, except along terrace escarpments where there is frequently a zone of from 100 to 400 feet wide where the surface is steep and broken. Many of these escarpments are very gravelly and have been mapped as Waukesha gravelly loam. Others have a sufficient covering of soil over the gravel so that they cannot well be classed as a gravelly loam type. The differences in elevation between terraces range from ten to fifty feet and more.

Over all of this soil drainage is well established and over much of the type it is inclined to be excessive, especially where beds of sand and gravel are within eighteen inches of the surface.

*Native vegetation.* This is a prairie soil and the original vegetation consisted largely of prairie grasses. Some timber was found along the Rock River and other streams and bordering some of the upland soils, but by far the greater part of it was treeless.

*Present agricultural development.* Next to the Waukesha silt loam, this is the most extensive of the valley-fill and terrace

types. Almost all of it is under cultivation, devoted to general farming in conjunction with dairying. Corn is the principal crop, and oats the second most important crop. Barley, rye, Irish potatoes, buckwheat, hay, sugar beets and tobacco are successfully grown.

*Waukesha loam, sandy phase.* The surface soil of the Waukesha loam, sandy phase, consists of a dark-brown to almost black fine sandy loam, comparatively high in organic matter, and very acid according to litmus tests. It is underlain at about twelve inches by a dingy-brown, fine sandy loam which grades downward into a brownish-yellow sandy clay loam. At twenty-four to thirty inches stratified beds of gravel and sand are encountered.

This phase is inextensive, being confined to the valley-fill area northeast of Beloit. The surface is gently undulating, but the drainage is usually excessive. About the same crops are grown, and similar yields are obtained, as on the Waukesha sandy loam, but the soil is considerably heavier than that type. The methods of improvement are similar to those suggested for the typical Waukesha loam.

For a discussion of the chemical composition of this soil and methods for its improvement, see page 44.

### CARRINGTON LOAM.

*Extent and distribution.* Carrington loam is found most extensively in Beloit and Newark Townships; though a few scattering areas are also found in most of the townships in the west half of the county. The largest continuous areas which are in the town of Beloit cover 3½ square miles.

*Description.* The soil of the Carrington loam is dark-brown to almost black, friable loam, 3 to 12 inches deep, comparatively high in organic matter. The upper subsoil is a dingy-brown loam to light clay loam, passing at about 17 inches into a yellowish-brown sandy clay, the latter continuing to a depth of 36 inches or more. Considerable gravel is present in both soil and subsoil and bowlders are common. In many places the underlying limestone is encountered in the 3-foot section and in such situations a gritty red clay carrying fragments of weathered limestone, overlies the rock. There are many small inclusions of Carrington fine sandy loam and silt loam, and in places

the fine sandy loam areas are so numerous that it is difficult to determine the predominating type. On some of the steep slopes the surface soil has been removed by erosion and the sandy clay loam or sandy clay subsoil is exposed. Where this type borders the Miami soils it is lighter in color than typical.

*Topography and drainage.* The surface of this type is for the most part gently rolling with some included tracts which are rolling. Modern farm machinery can be used to good advantage on practically all of the type and the natural surface and under drainage is excellent. Where the rock comes close to the surface the soils are somewhat draughty. On some of the steeper slopes, gullies have been formed, but with proper caution in cultivation and crop selection, these can be prevented. There are no marshes in the region where this soil occurs.

*Native vegetation.* This type is a prairie soil, and the most extensive native vegetation was prairie grass. In places there was a scattered tree growth, but never enough to class this as a timbered soil.

*Present agricultural development.* Probably 80 per cent of this type is cultivated. The remainder supports a growth of prairie grasses, and is used for permanent pasture. General farming in conjunction with dairying is the chief type of agriculture, with oats, corn, barley and hay as the leading crops. Tobacco is the only special crop grown.

The acid condition of the soil often prevents the growing of clover and alfalfa. As a whole, the methods followed are very similar to those practiced on Carrington silt loam under which type description a fuller discussion will be found.

For a discussion of the chemical composition and methods for the improvement of this soil, see page 44.

## CARRINGTON FINE SANDY LOAM.

*Extent and distribution.* Except for a few small areas in the town of Fulton and a limited area west of Evansville, the Carrington fine sandy loam is confined to the southwestern part of the county. The largest unbroken area is in the town of Beloit with other important tracts in the northern part of Newark and less important patches in several of the adjoining towns.

*Description.* The Carrington fine sandy loam, to a depth of about 10 inches is a dark-brown to almost black fine sandy loam, high in organic matter. A small quantity of gravel and sometimes limestone and chert fragments are scattered over the surface and mixed with the soil. Litmus paper tests indicate that the soil is in an acid condition. The upper subsoil is usually a yellowish brown fine sandy loam, grading at 16 to 20 inches into a sandy clay loam or sandy clay, which often extends to a depth of 3 feet or more. In many places, however, the underlying limestone is within the 3 foot section and from 4 to 6 inches of reddish-brown, rather plastic sandy clay, containing particles of decomposed limestone, usually overlies the rock.

*Topography and drainage.* The surface of this type ranges from gently rolling to rolling, with most of it being rather rolling. The slopes are not steep, however, and modern farm machinery can be used on practically all of it. Because of the loose porous nature of the subsoil and the broken character of the underlying rock the natural drainage is excellent. On the lighter portions of the type, the drainage is somewhat excessive. This condition also prevails where the limestone is found near the surface.

*Natural vegetation.* This is also a prairie soil, and the natural vegetation included only a few scattering trees. The chief growth was prairie grasses.

*Present agricultural development.* About 80 per cent of this type is under cultivation and devoted to general farming. It is considered a fair soil and easy to work, but is not equal in productiveness to the Carrington silt loam. The general farm crops common to the regions are grown, and tobacco is also raised to some extent. The heavier phases of the type are especially well suited to tobacco. Potatoes are also grown more extensively than on the heavier soils of the county. In general it may be said that the same methods of farming are followed as on the silt loam type. Land values range from $75 to $150 per acre, depending upon location, improvement, depth of soil, etc. The acid condition of the soil is frequently the cause of failure with clover and sometimes prevents the growth of alfalfa.

Methods for the improvement of this soil are discussed on page 44.

## CHEMICAL COMPOSITION AND IMPROVEMENT OF LOAMS AND FINE SANDY LOAMS.

In this group of soils there are ten separate types all of which are of minor importance individually but collectively the group is important since it covers a total area of 80,844 acres or about 18 per cent of Rock County. These soils are somewhat lighter in texture than the silt loams but where general farming is carried on practically the same methods of improvement can be followed as outlined for the silt loam soils on pages 26-30.

While there is some variation in the texture, structure and color of the types of soil in this group there is a sufficient similarity so that general methods of improvements discussed here will apply to the entire group.

Tests and observations which have been made on these soils indicate that practically all of the types are in need of lime. The dark colored prairie soils show a greater need than the light colored soils. There are a few exceptions to this need and these are found where the underlying limestone comes close to the surface as it does in a few places in the western part of the county. Frequently, however, the soil will be in an acid condition even when the limestone is within one foot of the surface.

The supply of organic matter in the dark colored types such as the Waukesha and Carrington loams and Carrington fine sandy loam is somewhat greater than the light colored types but in older cultivated soils this organic matter is in an inactive form so that the introduction of decaying vegetable matter will greatly aid in the improvement of these types regardless of color.

The supply of phosphorus in these loams and fine sandy loams is lower than in the heavier types and these soils show a marked deficiency in this element. The actual number of pounds of phosphorus which these soils contain, however, is not a true index of the actual need of this element. Some of the soils which show a small total amount do not respond as well to an application of the phosphorus fertilizer as do the types which have a large amount present so that the behavior of the crop is a more important indication of the need of phosphorus than the chemical analysis.

Regarding the supply of potassium in the soil the total amount is approximately 25,000 pounds per acre or fully 20 times as

much as the supply of phosphorus. Where general farming is conducted and where there is maintained a good supply of vegetable matter in the soil this will doubtless be sufficient. Where special crops are raised which require a large amount of potassium this element may be supplied to advantage in the form of a commercial fertilizer.

The principal characteristics of these types is that they hold somewhat less water than heavier soils do and they warm up more quickly in the spring. This together with the readiness with which they can be worked adapts them to truck and special crops, the growing of which requires more hand labor than is involved in the growing of staple crops. It is necessary to give them somewhat more attention to maintain fertility partly because of the fact that they are lower in fertility than the heavier soils but more because of the fact that these special crops require a higher degree of fertility to produce satisfactory yields. When these soils are used for the production of special crops their fertility can be maintained either through the use of rather heavy applications of stable manure or through the use of a rotation in which a legume is grown as the means of securing the necessary nitrogen and organic matter while the other elements, chiefly phosphorus and potassium, are supplied in commercial fertilizers. When this latter system is followed one-third or one-fourth of the land should be sown to a legume such as clover or soy beans which have large powers of gathering nitrogen from the air, and a part of the phosphorus and potassium should be used for the growth of different green manuring crops. The fertility used in this way will become available for the succeeding crops through the decomposition of the legume when plowed under and the remainder of the fertilizer to be used should be applied on this ground at the time of fitting it for the succeeding crops.

# CHAPTER IV.

## GROUP OF SANDY AND GRAVELLY SOILS.

### MIAMI GRAVELLY LOAM.

*Extent and distribution.* The Miami gravelly loam is confined to the north half of the county, and is well distributed throughout the region covered by the late Wisconsin drift. The most continuous area occurs west and southwest from Evansville, and is nearly seven miles long and from one-fourth to one-half mile wide. There is a large number of very small areas of this type.

*Description.* The Miami gravelly loam to a depth of six to ten inches is a light-brown to brown loam, carrying considerable gravel. The subsoil is a yellowish-brown to reddish-brown, friable gravelly loam or gravelly clay loam. Many small areas of gravelly fine sandy loam, fine sandy loam, loam, and silt loam are included with the Miami gravelly loam. North of Johnstown and Johnstown Center the inclusions of Miami silt loam are so numerous that it is difficult to determine whether it or the gravelly loam is the predominating type. Beds of gravel frequently occur in the deep subsoil.

*Topography and drainage.* The surface varies from gently rolling to broken and hilly, with numerous hummocks, kettle basins, and ridges. Except in the depressions the natural drainage is very good and often excessive. The surface is such that practically all of the modern farm machinery can be used. A possible exception would be bordering kettle holes which are all of small individual extent.

*Native vegetation.* The original timber consisted chiefly of oak, hickory, and maple, but most of the merchantable timber has been removed.

*Present agricultural development.* About 20 per cent of the Miami gravelly loam is under cultivation and utilized for growing of corn, oats, rye, and clover. In 1919 there were 2,002 acres of alfalfa in the county, and a large part of it is produced

on this type of soil. Crop yields are about the same as on Miami fine sandy loam.

The portion of the type not cleared is utilized chiefly for pasture, and on account of the rolling nature of much of the type, it is best suited to permanent pasture. This will prevent serious erosion.

*Chemical composition and improvement.* The Miami gravelly loam is somewhat variable but corresponds quite closely with the Miami loam and Miami silt loam in its chemical composition. It differs from these types chiefly in the presence of gravel mixed with a subsoil which is usually more open and porous. Its topography is also somewhat more broken so that the natural drainage is in all cases excellent. The gravel occuring with the type is almost entirely limestone gravel, and the type as a whole contains more lime than any of the other types of this series.

The supply of nitrogen in this soil is rather low and the supply of phosphorous is only fair. The potassium supply is sufficient for all of the ordinary farm crops.

In the improvement of this soil it is important that organic matter should be supplied and that the phosphorous content of the soil should be increased. Because of the high lime content, especially of the subsoil, this type is especially adapted to alfalfa, and by growing this legume, a large amount of organic matter can be readily secured. This soil, as a matter of fact, is probably better suited to alfalfa than any of the other types in the county. Alfalfa, however, is a strong feeder on phosphorous, and even though there should be available a good supply of stable manure, this should be supplemented by a phosphate fertilizer. Acid phosphate gives excellent results and may be applied along with manure or it can be applied with a fertilizer attachment to a grain drill at the time that the small grain is seeded. About 300 pounds (16 per cent) per acre is a good application.

As this type is quite rolling in places, it is frequently subject to erosion, and it is therefore desirable to keep the surface covered with a growing crop as much as possible. When alfalfa is being grown, it is well, therefore, to keep it as long as a good stand can be maintained. On breaking up alfalfa corn can be grown for one year followed by a small grain, after which the field may again be seeded to alfalfa.

### RODMAN GRAVELLY LOAM.

The surface soil of the Rodman gravelly loam, extending to an average depth of about ten inches, is a brown gravelly sandy loam, passing through a brownish-yellow gravelly sand loam which at about fifteen inches becomes more yellowish. Below this the gravel content rapidly increases. Stratified beds of gravel and sand are commonly encountered in the three foot section, and below this is usually a mass of stratified gravel and sand of undetermined depth.

This type is of limited extent and occurs only in Janesville Township, on the steep terrace escarpment along the east side of Rock River. The drainage is excessive, and the type is not under cultivation.

This type is quite similar to the Miami gravelly loam in the general character of its soil section, except that the depth to the underlying beds of gravel is less in this type. It is, therefore, more droughty. It also has a rough surface, and is extremely bumpy and irregular in topography. Its general composition is very similar to the Miami gravelly loam. This type can best be utilized for grazing since most of it is too steep to be used for cultivated crops. It supplies good pasture in the spring and early summer, but this usually dries up in midsummer unless there is a well-distributed rainfall. This land should be kept in permanent pasture.

### CARRINGTON GRAVELLY LOAM.

*Extent and distribution.* The Carrington gravelly loam is confined to a number of small areas scattered throughout the larger areas of the Carrington soils west of Rock River and in Milton and Fulton Townships. The largest area of about one-half square mile is east of Footville in Plymouth Township.

*Description.* The Carrington gravelly loam to a depth of about seven inches is a dark-brown, gravelly sandy loam, high in organic matter. This is underlain by a yellowish-brown, gravelly sandy loam, which becomes heavier with increase in depth, until a gravelly sandy clay is encountered at about twenty-four inches. This often continues to a depth of three feet or more. Crystalline bowlders are common, both on the surface and in the subsoil, and in many places, especially on

SOIL SECTION IN WAUKESHA SILT LOAM.

Showing beds of stratified gravel lying below about three feet of very silty material, which forms the surface soil and subsoil.

VIEW ON CARRINGTON SILT LOAM.

This view shows the typical surface features on the level prairie land mapped as Carrington silt loam. The level areas are also typical of the Waukesha silt loam.

VIEW OF RODMAN GRAVELLY LOAM.

The rough, broken areas of this soil are best suited to grazing and forestry.

300 lbs. acid phosphate
Yield 87 bushels

No treatment
Yield 69.5 bushels.

Oats on black prairie land at Dodgeville, Wis., 1918. The prairie lands of Rock County respond in a similar way to the use of phosphate fertilizers.

kames and eskers, stratified beds of gravel and sand are encountered in the three-foot section. In such cases the surface soil of gravelly sandy loam passes at about seven inches into yellowish-brown gravelly sandy loam, which grades downward into the beds of gravel and sand. Most of the gravel is limestone.

*Topography and drainage.* The surface is ridgy and very broken. Where the type occurs in the region of the late Wisconsin drift near Fulton, it contains numerous kettle basins, but the areas in the pre-Wisconsin drift are thoroughly drained by streams. Much of the type is found as kames and eskers which belong to either the late Wisconsin or the pre-Wisconsin drifts. The drainage is everywhere sufficient, and in many places excessive.

*Present agricultural development.* The type is of little importance, only about 20 per cent of it being under cultivation. The remainder is in permanent pasture. The chief crops grown are corn, oats, barley and hay. Yields are fair but somewhat lower than on the fine sandy loam. The surface soil is acid in most places and liming is necessary for the best success with clover and alfalfa.

### WAUKESHA GRAVELLY LOAM.

The surface soil of the Waukesha gravelly loam is a dark-brown to almost black, gravelly sandy loam, 8 to 12 inches deep. The subsoil is a brownish gravelly sandy loam, becoming brownish yellow at about 16 inches. At 20 to 30 inches beds of stratified sand and gravel are encountered. As mapped, the type includes some small areas of gravelly loam.

The Waukesha gravelly loam occupies steep valley slopes along Turtle Creek, Rock River and numerous tributaries which have cut their way back into the areas of valley fill. The drainage is excessive and the type has no agricultural use except as permanent pasture.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF CARRINGTON AND WAUKESHA GRAVELLY LOAMS.

Since the soil of these types is extremely gravelly in its character, has a steep surface, and therefore unsuited to a large degree for the growing of cultivated crops, it will probably not be advis-

able to attempt to improve it as is the case with other types. It is utilized at present to a certain extent for grazing, and this is doubtless the best practice to follow upon it. During the spring and early summer when there is a large amount of moisture present, it supplies fair pasture, but later in the season the grass dries up. In many places the steep slopes would in themselves prevent the growing of cultivated crops. The type may be considered as being of low agricultural value, and as it is of limited extent, it is of minor importance. Where small tracts of Waukesha loam are included their improvement may be directed along lines suggested for that type.

### PLAINFIELD FINE SAND.

This soil is of limited extent and of minor importance in Rock County. Its total area does not exceed 1,000 acres, and it is found in a few small tracts in Milton Township and along Taylor Creek and Sugar River, in Spring Valley, and Avon Townships.

The surface soil to a depth of eight inches consists of a light brown fine sand which contains only a small amount of organic matter. This is underlain by a yellowish fine sand which extends to a depth of three feet or more. Part of the type which occurs in Spring Valley and Avon Townships is somewhat coarser in texture than typical but there is not a sufficient amount of this to warrant mapping another type. Gravel is sometimes found in the subsoil.

The surface of this soil is flat to very gently undulating, and the natural drainage is excessive. The soil is inclined to be droughty although the water table comes closer to the surface than in the upland soils.

Approximately 40 per cent of this soil is cleared and under cultivation. The remainder is in brush, and second growth timber, and is used to some extent for pasture. Most crops common to the region are grown but average yields are low. The soil is deficient in organic matter as well as in the mineral plant food elements. The texture of the soil is such, however, that its productivity can be successfully improved.

To improve this type legumes should be grown, and to succeed with these it may be necessary to use commercial fertilizers. For this purpose a mixed fertilizer will be best, and a

2-10-4 will be well suited to this sandy soil. About 200 or 300 pounds per acre should be used. When clover is well established, a second crop may be plowed under to supply the needed organic matter. Where acid, the soil should be limed before best results can be expected from the mixed fertilizers. The use of lime will help to insure the success of clover. By following a short rotation in which a legume is grown and a part of it plowed under, and by supplying the mineral plant food elements through commercial fertilizers, very good crops may be secured. A rotation consisting of clover, corn or potatoes followed by a small grain is well suited to this soil.

### WAUKESHA SANDY LOAMS.

The total area of this soil does not exceed five and one-half square miles. It is found chiefly in Beloit and Rock Townships on terraces bordering Rock River. It also occurs in the southwestern part of the county as a terrace along Sugar River.

The Waukesha sandy loam to an average depth of about eleven to thirteen inches consists of a dark-brown to almost black sandy loam underlain at about sixteen to twenty inches by a brownish-yellow sandy clay loam. This becomes lighter in texture with increasing depth until a yellowish sandy loam is encountered at about twenty-eight inches, grading quickly into a gravelly loamy sand, and at about thirty-six inches into stratified beds of gravel and sand. Litmus paper tests indicate that the surface soil is acid.

As mapped, this type is somewhat variable. The surface soil of included areas ranges from sand to loam. The stratified beds of gravel and sand are within eighteen inches of the surface in some places, while in others they are not encountered in the three-foot section.

The surface of this type is level to undulating and the natural drainage is good, and because of the coarse open nature of the lower subsoil, it is frequently excessively drained and becomes droughty.

The type was orginally prairie and did not support a growth of timber. Prairie grasses made up the native vegetation.

Practically all of this type is devoted to general farming in conjunction with dairying. Potatoes are grown more extensively than on the heavier soils and fair yields are usually se-

cured. Yields of general farm crops are somewhat lower than on the Waukesha loam and silt loam and the type is of lower agricultural value.

Methods followed are practically the same as on Waukesha loam but are not those best suited to the building up of the fertility of this type. The best methods for the improvement of this kind of soil are discussed below.

### WAUKESHA SAND.

This type covers a total area of about three square miles and is confined almost entirely to the terrace along the north side of Sugar River between Brodhead and Avon in Avon Township.

The surface soil is a dark brown loamy sand fourteen inches deep grading into a yellowish-brown loamy sand which at about twenty-four inches becomes more of a yellow color, and is loose and open in structure.

The surface is level or very gently undulating and the natural drainage is excessive, this type suffering from drought every season. Some of the surface irregularities appear to be due to wind action. Along fences there are frequently low drifts of sand. North of Avon there is a small area occupying a slope below outcrops of sandstone. This is probably not of alluvial origin. The soil is mostly of alluvial origin, and was deposited by the streams when the waters were much higher than at present, probably during glacial time. Much of the material originally came from sandstone, and is now in an acid condition.

This is a prairie or semi-prairie type, there having been but very little scattering timber upon it. About 75 per cent of it is now being cultivated. It is devoted to general farming, but owing to its droughty nature and low content of plant food, average yields are low. The supply of organic matter is limited, and the methods of farming followed upon it are not such as tend to increase the supply of humus.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF WAUKESHA SANDY LOAM AND WAUKESHA SAND.

These soils are quite similar and may be discussed together. The sandy loam covers a total area of nearly 13,000 acres while

there are less than 2,500 acres of the sand. The sandy loam contains more clay and is a somewhat better soil than the sand.

The nitrogen supply is only a little more than half that found in Waukesha silt loam and the phosphorus is also lower than in the heavier types. The potassium is about two-thirds that in the silt loam. Analyses of Waukesha sand in other areas indicate that its supply of plant food is lower than that of the sandy loam. It will be noticed, however, that the plant food content of these dark colored sands is higher than that of the light colored, light texture soils.

In the improvement of these soils the first step is to supply the lime which is needed. This will require from 2 to 3 tons of ground limestone per acre. This should be applied to a plowed field and disked or harrowed into the soil to insure thorough mixing and an intimate contact between the soil grains and the limestone.

The management of these soils to maintain the fertility will depend to a considerable extent on the crops grown and on whether or not stock is maintained to which the produce of the farm is fed. When dairying or other live stock farming is practiced it will be less difficult to maintain the supply of the essential elements of plant food—phosphorus, potassium and nitrogen. But even when stock is maintained it is very probable that the moderate use of some form of phosphorus fertilizers will be found profitable, and some means for increasing the organic matter in addition to the use of stable manure should be made use of as far as practicable. The growth of a crop of soy beans or clover, occasionally, to be plowed under as a green manuring crop, will be found very profitable in its effect on the succeeding crop of corn or grain.

When these soils are used for the growing of potatoes or other special crops to a considerable extent the use of commercial fertilizers containing phosphorus and potassium will be found necessary to maintain the soil productivity. Clover or some other legume must be grown regularly in the rotation to maintain the nitrogen and organic matter, and part or all of this should be plowed under. It is often desirable to use the commercial fertilizers containing phosphorus and potassium in order to secure a good growth of clover and there is little loss in so doing, since essentially all of the phosphorus and potas-

sium applied to the soil for the clover becomes available to the succeeding crop through the decomposition of the organic matter.

While the use of commercial fertilizers containing phosphorus and potassium is desirable in the management of these soils it must not be considered that this is an indication that they have less value than heavier soils which are relatively higher in these elements, for the growth of potatoes and other special crops. The fact that these soils become dry and warm early in the season makes them less subject to local frosts and the finer tilth which they develop fit them especially well for the growth of potatoes and some other root crops, since they are practically free from checking and cracking. The cost of the fertilizers is a comparatively small part of the total cost of growing these crops. Sandy loam soil is well adapted to the commercial growing of potatoes, and whenever possible the sandy loams should be selected for this crop in preference to sand types. A good rotation for the sandy loam soils consists of small grain, clover, potatoes or corn. For further suggestions on the management of these soils and for information regarding source and use of fertilizers consult Bulletins 204, 230 and 341 of the Experiment Station.

# CHAPTER V.

## GROUP OF POORLY DRAINED SOILS.

### CLYDE SILT LOAM.

*Extent and distribution.* The Clyde silt loam is one of the best soils in Rock County. It occurs principally in the southeast corner of the county, but many areas ranging from a few acres to several hundred acres are found in the flood plains of streams and in shallow basins in the upland in all sections of the county.

*Description.* The Clyde silt loam consists of 12 to 14 inches of dark-brown to black silt loam, very high in organic matter. The subsoil is a dark-gray silt loam, mottled with drab and yellow, passing at about 24 inches into a mottled brownish-yellow or drab, silty clay loam which may continued to a depth of three feet or more.

The type as mapped is not uniform. The surface 1 to 8 inches in many cases consists of peaty material. In flood plains a zone of peaty material, ranging from 1 to 10 inches, may be encountered in either the upper or lower subsoil. Occasionally along streams the black silt loam has been deposited over loam and fine sandy loam, while in other instances the surface material to a depth ranging from 1 to 10 inches is a light-brown silt loam, underlain by black silt loam or peaty silt loam, due to wash from adjoining high land.

*Topography and drainage.* The surface of this soil is low lying, flat or basin like and the natural drainage is poor. It usually has a very slight slope toward the drainage way along which it occurs.

*Native vegetation.* The original timber growth consisted of elm, ash, soft maple, willows, some sycamore and a little bur oak. Most of the merchantable timber has been cut, but in a few places there is still timber of good quality chiefly where the type has not been drained.

*Present agricultural development.* This is the strongest soil of the county. It is especially adapted to corn. Grasses make

a very rank growth. Small grains are not equal in quality to that produced on the light-colored silt loam soils of the upland. Alsike clover, timothy, sugar beets and cabbage do well. Peas are grown to some extent, but run too much to vines to give best results. When sufficiently drained the Clyde silt loam is without question the best corn land in the state.

The most common system of cropping consists of growing hay for one or two years, after which corn is grown for two years, a small grain crop being then usually sown, after which the field is again seeded to timothy or timothy and alsike.

The selling price of improved land of the Clyde silt loam ranges from $150 to $300 an acre, while unimproved areas range from $75 to $150, depending upon the location and drainage possibilities.

*Chemical composition and improvement.* Clyde silt loam is one of the four most extensive and important soils in Rock County. This type of soil has been formed largely from drying up of marshes and occurs associated largely with Miami silt loam which was formed by the grinding of glacial ice on limestone. These low lands have received the wash of lime from the uplands for centuries, and the type, therefore, contains at present more lime than do most of the upland soils. It is seldom in need of lime.

The total supply of mineral plant food elements is large and where the soil is typically developed, the elements are usually found to be well balanced. Over some areas the surface is somwhat mucky in character and in these localities the supply of phosphorus and potash is relatively low. This soil contains approximately 10,000 pounds of nitrogen in the surface soil, about 2,000 pounds of phosphorus, and from 30,000 to 40,000 pounds of potassium. The most marked feature of this type is the fact that the potassium in many cases is of low availability and crops, especially corn, sometimes turn yellow at an early stage and make poor growth. In such cases the use of some form of potash or strawy horse manure is necessary to remedy this condition. This ordinarily develops in patches of from one to several acres in extent.

The phosphorus supply is usually ample for a number of years after drainage. Such land as this must be manured eventually or comm- -ilizers containing potash must be used.

There is relatively a much larger supply of nitrogen than phosphorus and potassium. For this reason it is a good practice to use the manure on the upland soils which are deficient in nitrogen and apply mineral fertilizers to the low land when these are needed. In many cases which show a marked need of potassium during the first few years of cropping, usually where the soil is high in organic matter to a depth of a foot, this lack of potassium frequently disappears after a few years of cropping as a result of the settling of the surface so that deep plowing mixes up some of the soil high in potash.

The first step in the improvement of Clyde silt loam is that of course of drainage, and when thorough drainage is established this type is considered to be one of the best corn soils in Wisconsin.

### CLYDE FINE SANDY LOAM.

*Extent and distribution.* This soil is not extensive, but it is found in various parts of the county. It is most extensive in the flood plains of Coon, Bass, North Branch and March Creeks. There are also small areas in the flood plains of Rock River and Turtle Creek at Beloit.

*Description.* The soil of the Clyde fine sandy loam is a black or dark-brown fine sandy loam about ten to twelve inches deep, containing considerable organic matter. In places there is a two to eight inch layer of peaty material at the surface. The subsoil is a dark-drab fine sandy loam which becomes lighter in color with depth. At twenty inches a drab or gray fine sandy loam is encountered, passing into a sandy clay loam at about thirty inches. The subsoil is variable. In some places it consists of fine sandy loam to a depth of three feet or more, while in others a sandy clay is encountered at about eighteen inches, continuing to a depth of three feet or more. In all cases yellow mottlings are common throughout the subsoil.

A coarser variation of this type, having the texture of a sandy loam is recognized. The soil to a depth of ten or twelve inches consists of a dark-brown or black sandy loam, very high in organic matter. The upper subsoil is a dark drabbish-gray sandy loam, passing at about twenty inches into a drabbish-gray slightly gravelly sand, which continues to a depth of three feet or more. The principal occurrence of this soil is in the

flood plain of Sugar River, in the southwest corner of the county. Small areas are found along Taylor Creek and its tributary near Brodhead. The land is flat and poorly drained, and very little of it is under cultivation, its chief use being for hay and pasture.

*Topography and drainage.* The surface of this soil is all low and flat, and most of it is subject to overflow. On account of its position the water table is close to the surface, and the natural drainage is poor.

*Native vegetation.* The native growth on this soil consisted of swamp oak, willows, elm, ash, soft maple, sycamore, sumac, and alder. In open places coarse marsh grasses were abundant.

*Present agricultural development.* By far the greater part of the land is still in an undrained condition, and most of it is now unsafe for growing cultivated crops. Grass for pasture and hay are the chief returns from this soil at present. Where open ditches have been dug, fair yields of corn and small grains and tame hay are being secured, but not over five per cent of the type is improved.

*Chemical composition and improvement.* This soil is somewhat variable in its physical properties. Its supply of nitrogen, phosphorus, and potash is somewhat smaller than in the silt loam, but it contains more organic matter than do the light colored upland soils and contains a fair amount of phosphorus and potash. In its improvement drainage is the first and most important step. When this has been supplied, this soil is well adapted to the growing of general farm crops, but it is also well suited to special truck crops. Where favorably located, it should be devoted to these special trucks crops rather than to the growing of general farm crops. When well drained, it warms up readily, is easy to cultivate and therefore very desirable for the growing of crops which require intensive cultivation.

## PEAT.

Peat, as mapped in Rock County, consists of vegetable matter in various stages of decomposition, mingled with varying proportions of mineral matter. It typically consists of black or dark-brown, fibrous to rather finely divided vegetable matter, mixed with a small amount of fine sand and silt. The

depth ranges from $1\frac{1}{2}$ to 20 feet, averaging about 4 feet. The greater part of the Peat is quite fibrous, but in a number of places it is fairly well decomposed, so that it can be molded by the hands. When dry this well decomposed Peat somewhat resembles a black, carbonaceous clay. In areas of sandy soils Peat is frequently underlain by sandy material while in regions of heavy upland soils the underlying material is clayey in character. Most of the areas of peat are underlain by material as heavy as a loam, or heavier. The largest areas underlain by sand occur along Coon Creek in Newark Township. Probably 95 per cent of the remaining areas are underlain by heavy material.

Peat occurs most extensively in the marshes of Lima and Milton Townships, along Allen Creek south of Evansville, along Bass Creek between Forestville and Afton, and on Coons Creek. Smaller areas are scattered west of the Rock River.

The surface is low, level and very poorly drained. During early spring some of the marshes are entirely covered with water, but later in the summer many areas of Peat are sufficiently dry and firm to bear the weight of farm animals, so that they can be pastured or cut for hay where there is a growth of wild grasses. In the area covered by the Late Wisconsin morains the Peat beds largely occupy old lake basins, ponded valleys, kettle basins, glacial sloughs, and other depressions in the uneven surface developed by the glacial ice sheet, and small bodies are also developed in the flood plains of streams. In the remainder of the county, most of which is covered by pre-Wisconsin drift, the Peat beds are confined wholly to stream flood plains.

Peat has been formed through the growth and partial decomposition in the presence of water of a rank vegetation, the black or dark-colored material being formed largely from grasses and sedges, and that having a brown color chiefly from sphagnum moss. About the margins of the larger marshes, and over the greater part of the smaller ones, varying quantities of mineral soil from the adjoining higher land have been washed in and incorporated with the vegetable matter. Although the greater part of the Peat occurs within the region where the upland soils are made up in part of limestone material, some of it is in an acid condition. This is usually the case in the center

of the larger marshes, while many of the smaller ones are not acid.

The native growth in the Peat marshes consists of several varieties of grasses and sedges, arrowhead, cat-tail, various reeds and rushes, and sphagnum moss. On a few marshes tamarack is found.

Only a small percentage of the peat beds of Rock County have been ditched and reclaimed. Where thoroughly drained and properly handled, they produce good yields of corn, mixed timothy and alsike, oats, potatoes, onions, celery and cabbage. The potatoes are not of as good quality as these grown on sandy soil, and small grain is likely to lodge and be of somewhat lower grade than where grown on upland soil.

*Peat, shallow phase.* The shallow phase of Peat consists of 8 to 18 inches of black or dark-brown vegetable matter in varying stages of decomposition, mixed with more or less sand, silt, or clay. The phase is developed in small areas in the southeastern and northeastern townships of the county, along Waukoma, Allens, Marsh, Bass, Coon, Norwegian and Taylor Creeks, and Sugar River.

In topography, drainage, and character of vegetation this phase is similar to the typical Peat.

Some of the marshes are underlain with clay, clay loam, or silt loam at a depth of only 12 to 15 inches. When these are first drained there is often a marked need of potash fertilizer or barnyard manure for a few years, but later this need partially or entirely disappears. This seems to be due to the settling of the mucky layer upon being drained and worked, permitting the underlying material, which contains a good supply of potassium, to become mixed with the organic material so as to supply plants with potash.

### AGRICULTURAL VALUE AND DEVELOPMENT OF PEAT.

The amount of marsh land occurring in Rock County so well located with reference to market and transportation facilities makes it important to consider its agricultural possibilities quite fully. At present only a very small proportion of the peat soil in this county is improved.

The question of the actual value of marsh land is one which depends on several factors. In the first place, the farmer whose

land is largely upland and well drained can use a small amount of marsh land to very much better advantage than can the farmer whose land is essentially all marsh land. But probably the most important factor determining the value of marsh land will be the crops which can be grown on it. This depends on two factors, first the degree of drainage, and second the danger from frost. When only the main outlet and lateral ditches have been installed, in the great majority of cases hay crops are the only ones which can be safely grown, and the character of the hay will also depend a good deal on the character of the drainage. In the case of peat land underlain by sand the drainage by well-constructed and sufficiently deep ditches 40 to 80 rods apart will, in most cases, give adequate drainage for this purpose. When the peat soil is underlain by silt or clay, however, ditches not more than 20 rods apart will be necessary and these must lower the water in the ditch to a point 4 or 5 feet below the surface during part of the growing period. When tilled crops, such as corn, cabbage, or potatoes, or small grains are to be grown, the drainage must be more certain, and over the greater portion of our marsh lands this will mean the installation of drainage systems in the form of either open lateral ditches or of tile not more than 10 and often not more than 5 rods apart on the average.

Another factor which must be considered in comparing marsh and upland soils is that of fertility as determined by chemical composition. Marsh lands are abundantly supplied with organic matter containing nitrogen, but are relatively low in the elements phosphorus and potassium. The marsh lands of Rock County are rarely in need of lime since the acidity which ordinarily develops in marsh land is kept neutralized by the lime carried down from surrounding uplands. Some of the marshes in the southwestern part of the county show some need of lime. In the eastern part of the county the peat is seldom acid. Stable manure can be used for fertilizing marsh land, but it contains large amounts of nitrogen, which the marsh soil does not need and is relatively low in phosphorus and contains but a moderate amount of potassium. Moreover, weeds so commonly carried into the land with stable manure are especially hard to eradicate on this class of soil. Ordinarily, therefore, it is more satisfactory to use commercial fertilizers containing phosphorus and potassium on marsh soils than stable manure. At any rate this is

true when the farm contains some upland soils as well as marsh land, since the stable manure can be used on the upland while the commercial fertilizers are secured for use on marsh land.

Marsh lands are more subject to early fall and late spring frosts than are uplands, partly because of the fact that the cold air developing in contact with the soil as the latter loses its heat by radiation during the night, flows down and collects over the lower land, and partly because the loose, spongy nature of the peat soil prevents the heat of the sun from penetrating so that all except the mere surface is cool, and this loses its heat quickly at night, therefore increasing the tendency to frost. This loose character of the soil can be somewhat improved by the use of a heavy roller which firms the soil and so gives it better heat conductivity. This tendency to frost reduces somewhat the availability of marsh land for tender crops, but in Rock County, potatoes and corn on marsh lands are seldom injured by frost.

The large water-holding capacity of marsh soils together with their large quantity of nitrogen makes them suitable for crops, making strong growth of stock or leaf. Among the staple crops, hay and corn are best suited to such land. Special crops such as cabbage, hemp and sugar beets also do well, but these will require larger amounts of potassium and phosphorus fertilizers. The degree of drainage must also be considered in selecting the crop to be grown. Timothy and alsike clover for hay may be grown on marsh land having insufficient drainage to be adapted to corn or other crops requiring tillage.

## DRAINAGE.

In Rock County there are 75,200 acres of land which may be classed as poorly drained, and which must be provided with open ditches or tile drains before cultivated crops can be safely grown from year to year. This includes 52,672 acres of Clyde silt loam, 13,248 acres of peat, and 9,280 acres of Clyde fine sandy loam. In addition to these soils, there are places on the level prairie and also in the light-colored terrace soils where the lands are somewhat deficient in drainage, and where tile drains can be used with profit. It is safe to say that there are approximately 100,000 acres of land in Rock County which could be profitably improved by drainage.

The three soils mentioned above are, for the most part, unimproved, or are used only for grazing or for the production of wild or tame hay. The Clyde silt loam, when drained, makes one of the best types for corn in southern Wisconsin, and to have it in its present undrained condition is an economic loss. The peat is less valuable, but its improvement by drainage will greatly add to the producing possibilities of the county. The Clyde fine sandy loam is a good trucking soil when drained. Practically all of these lands can be successfully drained, and every farmer having poorly drained land should develop a plan by himself, or with his neighbors, for the improvement of these idle acres.

Where any area of low land includes part of several farms, the owners can form a drainage district and sell bonds to pay for the improvement. In this way, the cost of drainage can be spread over a number of years, and paid for from the products of the improved acres. Assistance in the development of such projects can—and, in fact, must—be secured from the state authorities who pass upon the practicability of the project before the court permits the organization of the district.

Since over sixteen per cent of the land in Rock County is failing to do its duty because of poor drainage, and since well-drained land adjoining is worth from $100 to $300 per acre, it would seem that the improvement of such land would be a matter of vital concern to the county as a whole. If this land were all in corn and properly handled, it would yield at a conservative figure over three million bushels per year.

For a more detailed discussion of the problem of drainage, see Bulletins Nos. 284 and 309, Wisconsin Experiment Station.

## CHAPTER VI.

## GENERAL AGRICULTURE AND CLIMATE OF ROCK COUNTY.

The system of agriculture followed at present consists of general farming with dairying as one of the most important and profitable phases. The chief crops grown in the approximate order of their importance are corn, hay, oats, barley, wheat, rye, tobacco, alfalfa, potatoes, sugar beets, peas, cabbages, beans and other miscellaneous truck crops. There are over 1,550 silos in Rock County, and nearly half of the corn is used as ensilage. The heavy soils of the Clyde series, when well drained, and the black prairie soils make the best corn land in the county.

The hay consists chiefly of clover and timothy. Medium red is the most popular clover. Some difficulty is experienced in getting and keeping good stands of clover, due in part to winter killing, and in part to an acid condition of the land, which is unfavorable to the growth of clover and other legumes. Hay is grown on practically all soils of the county, but does best on the heavier types.

Oats and barley are grown chiefly as feed for stock on the farm, but some is sold and shipped each year to the large market centers.

The growing of wheat decreased greatly after 1880, but during and after the late war, the acreage greatly increased. In 1918, a favorable year, the average yield was about thirty bushels per acre. Since then both acreage and yields have been considerably less. In 1919, the yield was fifteen bushels per acre.

Alfalfa is justly increasing in favor, and the acreage is gradually increasing, which is encouraging, as this is an excellent feed and a good soil builder. Tobacco is an important special crop. Through the practice of heavy fertilization of this crop on the same field year after year, other parts of the farm are robbed of their fertility for the sake of the tobacco patch. To equalize the distribution of manure, the tobacco field should be

rotated to different parts of the farm, and the crop should be grown in rotation with other crops.

The growing of sugar beets, while limited at present, could well be extended when the crop insures a profit, since there is a factory at Janesville. They do well on practically all of the heavy types of the area. Peas for canning seem to be best on Miami silt loam, although they are successfully grown on most upland types of the area.

Dairying is the most important branch of farming. The Holstein is the predominating breed, though the majority of the cows are grade stock of good breeding. In 1919 there were 37,914 milk cows in the county.

There is some feeding of steers for the Chicago market, but this is much less common than dairying. Hogs are raised extensively in conjunction with dairying and also with feeding cattle. On January 1, 1920, there were 69,960 hogs in the county.

### ADAPTION OF CROPS TO SOILS.

It is recognized in a general way that different soils are adapted to different types of farming. The gravelly loam types are mostly too rough for the growing of general farm crops, and farmers realize that they are best adapted for pasturage. It is a well-known fact that crops on low-lying land are most susceptible to frost. All the farmers are beginning to recognize differences in the adaptation of soils to certain crops and varieties, and the majority are guided in a measure by such knowledge, but few carefully select their fields on soils best adapted to a particular crop. It is generally considered that corn does best on the heavy Clyde silt loam, and it is well suited to all the heavier, dark colored soils, such as the Carrington and Waukesha silt loams. On these dark soils, high in organic matter, small grains are apt to lodge, and the quality of the grain is not so good as on the light colored, heavy types. Peas do best on the Miami silt loam and Fox silt loam chiefly on account of the high lime content, while potatoes of the best quality are grown on the sandy and fine sandy loam soils. The sugar content of beets grown on the Carrington silt loam, Waukesha silt loam, and Clyde silt loam is lower than that of beets grown on the Miami silt loam and Fox silt loam, but the yield

is enough higher to give a little better net return. Tobacco is grown most extensively on the Miami and Carrington silt loams, both being well adapted to the crop. The choicest land for tobacco seems to be near areas of Carrington fine sandy loam where a little fine sand is mixed with the Carrington silt loam. The lighter textured soils are considered the best for trucking. It must be recognized, of course, that when a crop is well suited to a certain soil, that crop cannot be grown on it to the exclusion of other crops, because rotations must be followed to insure keeping up the fertility of the soil. For example, on good corn land, corn should not be grown every year on the same field. It may be grown two years in succession, however. When the land is not so well suited to it, corn may be grown only one year in the rotation.

### METHODS.

The tendency throughout Rock County is toward better methods of cultivation, fertilization and seed selection, and as a result, yields are being increased. Where the soil is droughty but not subject to erosion, fall plowing has been found helpful in the conservation of moisture. Often the heavy sod soils are plowed in the fall. It is customary to apply stable manure to land that is to be plowed for corn, but if the land is plowed in the fall the manure is often hauled out during the winter and scattered over the plowed surface. When stubble land is plowed in the late summer, manure is frequently applied before plowing. Where tobacco is grown, it receives practically all of the manure, and the field soon becomes the richest on the farm. It is easier to use the same field year after year than to change the crop, and tobacco has often been grown in the same field for from five to ten years, and in some instances for fifteen years. This condition can be improved by following a rotation of tobacco with other crops as outlined on page — under the discussion of rotations. Throughout the county most of the farmers plan to seed their land to grasses at least once every four or five years.

### FARM EQUIPMENT.

The farm buildings, including the dwellings, are generally large and substantial. The barns usually have a stone or con-

crete foundation. Most of the dairy farms have a silo. The fences are good, many of them being of woven wire. The work stock consists of draft horses of medium to heavy weight. Modern farm machinery is in use throughout the county. There are a number of traction engines used for plowing as well as for other farm work. Machines for thrashing grain travel about the country serving the farmers soon after harvest. There are also numerous co-operative thrashing outfits owned by the farmers themselves.

### FARM TENURE.

The 1910 census reports the number of farms in the county as 3,787, comprising 95.9 per cent of the total land area. The average size of the farms in 1910 was 116 acres, of which ninety-five acres, or 81.8 per cent, was improved. The percentage of farms operated by owners was 66.8 per cent, by tenants 32.4 per cent and by managers .8 per cent. The 1920 census shows practically the same figures. Ordinarily where the landlord supplies the work stock and tools, he received two-thirds of the crop. Where the tenant supplies these in addition to his labor, the landlord receives one-half or one-third of the crop.

### FARM VALUES.

The selling price of the better farming land ranges from $125 to $300 an acre, depending on the quality of the soil, the topography, the improvements and the accessibility of markets. The highest priced lands, excluding farms near the cities and towns, are the level to gently rolling, heavy soils, especially the silt loams. The more rolling areas of heavy soils, together with the sandy loams, range in valuation from $75 to $125 an acre, while the areas of deeper sand types and some areas subject to overflow are valued at $40 to $75 an acre.

### IMPROVEMENTS IN METHODS OF FARMING.

There are about 100 farmers in Rock County who have had their farms examined by the State Soils Laboratory, and are now following instructions received for the improvement of their soils. This line of work has brought a soil expert to each farm, and careful examination has been made of the soil and subsoil.

Samples have been collected for chemical analysis, and observations made as to the methods of cultivation, fertilization, etc., followed. Upon the completion of the chemical work, reports are made for each farm, outlining methods for the permanent improvement of the soil on each farm. It has been found that through this line of work, practically all of the black prairie soils are acid and in need of varying amounts of lime. The phosphorus supply has also been found to be limited on most farms. On the light-colored soils, there has been found to be a deficiency in the nitrogen and organic matter supply and also in the amount of phosphorus found in the soil. As a rule the acidity is not so marked in the light-colored soils as on the prairie lands.

As a result of instructions which have been given through this service, the use of ground limestone has materially increased, and commercial fertilizers are used to a greater extent and with greater effectiveness than before this service was inaugurated by the Agricultural College.

The soils department of the university, through its extension specialist has started numerous co-operative fertilizer and lime demonstrations in Rock county. Farmers throughout the region are gaining much valuable information from these tests, which help to make every farm more productive.

Through the work of Wisconsin Experiment Association the importance of using good seed grains has been emphasized, and farmers are now paying more attention to the selection of their seed grains, with the result that both yields and quality have gradually increased. There are a number of farms within the county which make a business of raising pure-bred pedigreed seed grain.

## CROP ROTATIONS.

It is quite generally understood that the continuous growth of one crop on the same field takes fertility out of a soil more rapidly than does a rotation of crops. One of the most important farm practices, therefore, from the standpoint of maintaining fertility, is the rotation of crops on a basis suited to the soil, climate, farm, and market conditions.

One reason why a crop rotation is beneficial is that different crops require different amounts of the various plant food ele-

ments found in the soil. One crop will remove a large amount of one element from the soil, and the next crop, if it be the same kind, will suffer for the lack of that element. If some other crop which does not draw as heavily on that particular plant food is rotated with the former, a certain balance in available plant food is reached.

When cultivated crops are grown continuously there is a greater loss of organic matter or humus from the soil than is the case when properly rotated. The use of legumes in rotations is of particular value since when they are well inoculated and turned under they not only support organic matter to the soil, but they also increase the nitrogen content.

In any program of permanent soil improvement, therefore, one should adopt at the outset a good rotation of crops, including a liberal use of legumes, in order to increase the organic matter of the soil either by plowing under the legume crops and other crop residues, or by using as food and bedding practically all crops raised and returning the manure to the land with as little loss as possible. No one can say in advance what will be the best rotation for any farm because of the wide variation in farms, farmers, and the prices of farm produce.

It is of great importance that in selecting crops to grow, careful consideration be given to the question of climate. This is about the only factor which the farmer absolutely cannot control. A poor soil may be improved, better markets may be found, and better labor secured; but the farmer is powerless to change climatic conditions. He must, therefore, select such crops as are suited to his climate.

The soil is also a factor of great importance. As a general rule, small grain crops do better on heavy than on light soils, and the same is true of grasses grown for hay. On the other hand, the same variety of corn requires a shorter season for maturity on light than on heavy soil. Rather light soils and those of intermediate texture are better adapted to potato growing and root crops. Therefore, on light soils a greater acreage should be devoted to cultivated crops than on heavy types.

Shipping and marketing facilities must also be considered in planning a rotation. The farmer located on a sandy loam farm close to a railroad station or home market will often find it profitable to include potatoes in his rotation. If he is located

six or seven miles from a station, the profits from growing potatoes will be much lessened. It will then pay him better to raise more corn for stock feeding, and to convert his crops into dairy products which are less bulky, and which for the same bulk have a greater value.

Some of the other things which we should keep in mind regarding a good rotation are that it helps to control weeds. It also aids in controlling plant diseases, and serves to check insect pests. Following a good rotation increases the humus supply in the soil, and insures maintaining a good amount of available nitrogen in the soil. It helps to distribute the labor efficiently throughout the year. A good crop rotation means that the proper crops will be grown at the proper time and in the proper place, and this will aid in keeping the soil in proper sanitary condition. It will also increase net returns from each acre, and greatly improve the general appearance of the farm.

Following are a few suggestions which will apply to farms in the corn belt and they may serve as outlines to be modified according to varying conditions:

*Six-Year Rotation.*

1st year. Corn.
2nd year. Corn.
3rd year. Wheat or oats (with clover, or clover and grass).
4th year. Clover; or clover and grass.
5th year. Wheat (with clover); or grass and clover.
6th year. Clover; or clover and grass.

*Five-Year Rotations.*

1st year. Corn.
2nd year. Corn.
3rd year. Small grain with clover.
4th year. Clover.
5th year. Wheat with clover.

1st year. Corn.
2nd year. Small grain with clover.
3rd year. Clover.
4th year. Wheat with clover.
5th year. Clo-

VIEW SHOWING COMBINATION DAIRY AND TOBACCO FARM.

These two lines of farming are extensively developed in northern Rock and southern Dane Counties. In some sections tobacco growing is gradually giving way to the more extensive development of the dairy industry.

1st year. Corn.
2nd year. Cowpeas; or soybeans.
3rd year. Wheat with clover.
4th year. Clover.
5th year. Wheat with clover.

*Four-Year Rotations.*

1st year. Wheat.
2nd year. Corn.
3rd year. Oats with clover.
4th year. Clover.

1st year. Corn.
2nd year. Corn.
3rd year. Wheat or oats with clover.
4th year. Clover.

*Three-Year Rotation.*

1st year. Corn.
2nd year. Oats or wheat with clover.
3rd year. Clover.

In some of the rotations suggested it may be desirable to substitute rye or barley for wheat or oats. When clover is mentioned, it is meant to include the various clovers used, such as red, alsike, or sweet clover. The value of sweet clover is coming to be more appreciated and its importance in a crop rotation program may well be emphasized.

Tobacco can well be grown on the same field for from two to three years, followed by two years of corn and one of small grain seeded to clover. Phosphate fertilizer should be used to supplement manure. A second crop of clover can be plowed under and thus save some manure for other parts of the farm. Tobacco is grown chiefly on Miami and Carrington silt loams. A small amount of fine sand in these types seems to be a desirable characteristic.

The growing of peas for canning is important in some sections, and this crop may be introduced into the rotation very readily. A four-year rotation may consist of small grain, clover, a cultivated crop, followed by peas. This may be made a five-year rotation by adding timothy and cutting hay two years.

The growing of sugar beets is also an important industry, and beets may also be introduced into the rotation without difficulty. It is best not to have the beets follow or precede the corn, but the crop may follow barley or other small grain. Beets can be grown very successfully following tobacco since tobacco land is in a high state of fertility, and since the beets use a somewhat different combination of plant foods than does the tobacco, and draws more upon the subsoil.

A three-year rotation is popular on many of the dairy farms. It consists of grain seeded to clover, and the clover followed by corn or some other cultivated crop. Much the larger portion of the corn in this region is put in the silo to be fed to dairy animals. The clover is made into hay, and fed to stock. It is often possible to get two crops of medium red clover in one season. The second crop may be cut for hay, or may be pastured. Pasturing is advisable on well-stocked dairy farms. This three-year rotation may be lengthened into a four-year rotation by the addition of timothy so that hay can be cut two years instead of one year, or the land can be pastured the second year instead of cutting for hay.

Potato raising when properly managed is a profitable industry in many parts of the state. Although good crops may be grown on heavy clay soils, the sandy loams are especially well adapted to potato production. For best results, this crop should be grown in rotation with other crops, and should always follow a legume of some kind. Potatoes should not follow corn or corn potatoes, as both crops draw heavily on the fertility of the land. In the rotations which have been given, potatoes can be planted as one of the cultivated crops. It is better to apply manure to the clover crop rather than just before planting to potatoes, for scab is more common when potatoes are planted on freshly manured land. The three-year rotation just described is excellent for sections where potatoes are grown extensively, the potatoes taking the place of corn. As a rule cropping to potatoes oftener than once in three years is not recommended.

## LIMING.

Part of the land on practically every farm in Rock County is in need of lime. All of the soil types on the prairies show an acid condition which is usually slight to medium in degree.

The subsoil of the prairie types also show some acidity to a depth of from two to three feet. The light colored upland soils are usually slightly acid at the surface, but as soon as the gravelly or gritty layer in the subsoil is reached the material is calcareous and contains lime.

The soils which are least in need of lime are the Clyde series and the peat soils.

The degree of acidity is quite variable and each farmer may find a wide variation in acidity on his farm. Failure of clover and alfalfa is usually a sure, and one of the best, indications of the need of lime. About two tons of ground limestone per acre is the usual application. The amount to be used, however, may vary with the character of the soil and the crop to be grown. Such crops as alfalfa, sweet clover, peas, cabbage, onions and lettuce have a high lime requirement. Clover, garden beans, barley, hemp, turnips and radishes have a medium lime requirement, while vetch, white clover, oats, rye, blue grass, potatoes, sorghum and others have a low requirement for lime. As a rule the heavy types of soil which are acid need more lime than the sandy types showing the same degree of acidity.

Ground limestone is doubtless the most economical form of lime which can be extensively utilized in Rock County. Lime should be applied previous to planting the crop which is to be benefited. It should be applied to plowed land and thoroughly worked in by harrowing. Either fall, winter or spring applications may be made on heavy soils, but on light soils spring application is preferable.

The best way to apply lime is with a regular spreader made for this purpose, and there are a number on the market. A manure spreader may also be used by first putting in a thin layer of manure and spreading the limestone evenly on top of the manure. Where several farmers are so situated that they can work together, a lime spreader may be secured jointly for this purpose.

After making a first application of two tons per acre, it is not likely that another application will be needed for four to six years, and the need should be determined by the story which the crops themselves tell.

It should be remembered that most acid soils are also deficient in available phosphorus, but applying lime will not add to the

total amount of phosphorus in the soil. The need of phosphorus may be so great that but little result will be secured from liming until phosphorus is also added. Frequently the application of phosphorus alone to an acid soil will result in larger increases than the use of lime alone, and for this reason it is important that both deficiencies should be corrected to secure the most economical production.

### DISTRIBUTION OF LIME, COMMERCIAL FERTILIZER AND MANURE.

Phosphate or other fertilizers or lime should be uniformly distributed, so that some will be near every plant. Ground limestone is applied at the rate of from 2,000 to 4,000 pounds or more an acre, while with phosphates and other fertilizers the amount applied for staple crops is usually from 75 to 400 pounds. It is difficult to construct a machine which will satisfactorily distribute both fertilizer and limestone, although such machines are on the market and also others for distributing each separately. The fertilizer distributor may be a part of a grain drill or a separate machine. The machine for distributing ground limestone should be provided with a double agitator so as to secure continuous feeding.

End gate seeders which will distribute proper amounts of either fertilizer or ground limestone fairly well are available.

When a fertilizer distributor is not available the acid phosphate or other fertilizer may be spread evenly over the manure in the manure spreader, and so receive a very fair distribution. This method will give very good results until such time as a grain drill with fertilizer attachment can be purchased. The amount to be applied on each spreader load must be calculated so the right amount per acre will be applied. An old drill or seeder may also be used to distribute the fertilizer going ahead of the grain drill.

The care and use of the manure produced is an important factor in the management of dairy and stock farms. The chief advantage of these types of farming is that the proper use of the manure or other waste products makes it possible to maintain profitable yields with comparatively little purchased fertilizer. But it is only when intelligent care is taken that this result is possible. Much of the available plant food in manure is readily soluble in water, so that if the manure is exposed to the rain

in flat or shallow piles, a considerable part of its value is lost. This affects nitrogen and potash especially. It is important also to recognize that a large portion of these elements is in the liquid part of the manure and that it is necessary, therefore, to use bedding or absorbents freely to prevent a considerable loss. This is particularly true of potash, about 60 per cent of which is contained in the liquid manure.

Ordinarily the best practice is to haul the manure directly to the field. When this is not practicable the pile should be kept compact, well trodden and moist as it can be through the use of a slightly saucer-shaped manure pit, from the outer sides of which the ground slopes away so as to prevent water washing into the pit itself. In this climate the use of shelter is of doubtful importance, though where more rains occur, particularly in the winter, a shed roof is very helpful.

The rate and frequency with which manure is applied depends in part on the character of the soil on the farm. On lighter soils more frequent applications of smaller amounts are desirable than on heavier soils. Five or six loads per acre every third year are desirable on the sandy loams, while eight to twelve or more every fourth or even fifth year may be used to advantage on heavier soils.

## CLIMATE.

Almost all of Rock County is included within the Rock River Basin, which is one of the eight climatic provinces in Wisconsin. This province has the longest growing season of any in the State, averaging about 170 days, which is as long as that of central Illinois, longer than that of central Indiana or Ohio, and about equal to that of the Valley of Virginia and that of central Maryland. Weather Bureau records taken at Beloit indicate that at that station there is a growing season of 181 days free from frost.

The mean annual temperature for Rock County is 47.3° F. The winters here are colder than along the lake, and the spring and summer are warmer. This section is the best corn area in the state. The temperature of the Rock River Basin in summer is similar to that of northern Illinois, Indiana, Ohio, and southwestern Pennsylvania, while in winter it is comparable with that of southern Vermont, northern Iowa, and southern Montana.

On seven summer days, on the average, each year the thermometer may go as high as 90° F., and during five winter mornings on an average it may fall to 10° F. below zero or lower. The highest temperature recorded in the county is 105° F., and the lowest 27° below zero. Such extremes are of rare occurrence and of short duration.

Records at Beloit show that the average date of the last killing frost in the spring is April 20, while the latest date of killing frost recorded is May 20. The average date of the first killing frost in the fall is October 18, while the earliest date of killing frost recorded is September 20.

The average annual rainfall of 32.71 inches is normally well distributed throughout the year, and especially during the growing season when most needed. The average for the three spring months is 8.54 inches, for summer 11.31 inches, and for fall 7.38 inches. It is true, however, that during July and August there are occasional dry spells, during which crops actually suffer from the lack of moisture. Dry spells may occur in the fall also, but as the crops reach, or approach maturity, a reduction in the supply of soil moisture is not so serious a matter as when the plants are making the main part of their growth. While these dry spells frequently cause a reduction in the yields, they have never been so severe as to cause even an approach to a crop failure.

In the following table are shown the more important climatic data as compiled from the records of the Weather Bureau station at Beloit:

TABLE SHOWING MEAN, ANNUAL, AND SEASONAL TEMPERATURE AND PRECIPITATION AT BELOIT, WIS.

(Elevation of Station, 750 feet.)
(Length of record, 17 years.)

| Month | Mean temperature | Highest temperature | Lowest temperature | Mean precipitation | Average number of days with .01 inch or more of precipitation |
|---|---|---|---|---|---|
| December | 24.0 | 58.0 | —25 | 1.89 | 6 |
| January | 20.4 | 59.0 | —27 | 1.88 | 17 |
| February | 19.9 | 59.0 | —24 | 1.71 | 6 |
| Winter | 21.4 | 59.0 | —27 | 5.42 | 29 |
| March | 34.2 | 80.0 | — 4 | 2.21 | 5 |
| April | 47.5 | 84.0 | 18 | 2.77 | 6 |
| May | 58.7 | 91.0 | 27 | 3.56 | 7 |
| Spring | 46.8 | 91.0 | — 4 | 8.54 | 18 |
| June | 68.0 | 98.0 | 36 | 4.05 | 9 |
| July | 72.9 | 105.0 | 45 | 3.65 | 7 |
| August | 70.6 | 97.0 | 42 | 3.61 | 8 |
| Summer | 70.5 | 105.0 | 36 | 11.31 | 24 |
| September | 63.6 | 94.0 | 23 | 3.39 | 5 |
| October | 50.8 | 86.0 | 18 | 2.08 | 7 |
| November | 36.9 | 69.0 | — 4 | 1.91 | 5 |
| Autumn | 57.1 | 94.0 | — 4 | 7.38 | 17 |
| Mean Annual | 47.3 | 105.0 | —27 | 32.71 | 77 |

Average length of growing season, 181 days.

in conjunction with dairying. The principal crops are corn. oats, barley, clover, timothy, alfalfa, rye, buckwheat, and wheat. A number of special crops are grown, including tobacco, potatoes, sugar beets, peas, and cabbage. Hog raising is developed rather extensively, and some beef cattle are fed.

Land values range from $40.00 an acre on the sandy and more broken acres to $300 in the most highly improved sections.

The climatic conditions are favorable for general farming and dairying. The mean annual temperature is reported at Beloit as 47.4° F., and the mean annual precipitation as 32.71 inches. There is a normal growing season of 170 days for the general region of Rock County, but at Beloit records show a growing season of 181 days free from killing frosts.

1 sheet

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

ERNEST F. BEAN, Director and State Geologist
A. R. WHITSON, In Charge Division of Soils

SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE
H. L. RUSSELL, Dean

BULLETIN NO. 53C — SOIL SERIES NO. 22



# SOIL SURVEY

OF

# GREEN COUNTY

BY

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# GEOLOGICAL AND NATURAL HISTORY SURVEY

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# ILLUSTRATIONS

# INTRODUCTION

The State of Wisconsin, working in cooperation with the United States Department of Agriculture, is making a careful study of soils and agricultural conditions throughout Wisconsin and is preparing soil maps and soil reports of all counties in the state. A soil map shows the location and extent of the different kinds of soil. Tracts of 10 acres and more are mapped, but often areas of even smaller extent are shown. The soil map is prepared by trained men who go over a county thoroughly, and examine the soil by making a sufficient number of borings to a depth of 36 inches to take account of all variations. A report is also made, to accompany and explain the map, and this is based upon a careful study of the soils within the region surveyed and upon such other features as have a direct bearing upon the agriculture of the area.

It is the object of this survey to make an inventory of the soils of the state, and to be of practical help to farmers by locating and describing the different soils, by determining their physical character and chemical composition, and by offering suggestions for their management, based upon the work of the Soil Survey within the area covered in the report, and upon the results of field tests made by the Experiment Station.

Soil fertility depends upon two factors: First, upon the physical characteristics of the soil, such as water-holding capacity, work ability, etc., and second, upon the chemical composition of the material composing the soil. The chemical composition depends upon the mode of origin of the soil and the source of material from which the soil is derived.

Water-holding capacity and other physical properties of soil all depend chiefly upon texture, which refers to the size of the individual soil grains, or particles. A coarse

sandy soil, for example, will not retain moisture as long as a loam soil, or clay loam, because the finer the soil grains, the greater will be the total soil grain surface area to which moisture may adhere.

Texture is determined in the field by rubbing the soil between the thumb and fingers, and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a mechanical analysis, which is made by a method of separating soil grains into seven different groups. These are known as clay, silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel.

A chemical analysis is also made of the soil to determine the amounts of various essential plant food elements which are present. A chemical analysis shows whether the soil contains a large store of plant food or only a small quantity, and it indicates which kinds of plant food will probably be needed first. The amount of organic matter in the soil is also determined, and tests are made to show conditions relative to soil acidity.

### Soil Classification

Soils are grouped according to texture into soil *classes*, a soil *class* being made up of soils having the same texture, though differing in other respects. A certain fine sand, for example, may be light colored and of alluvial origin, another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind; yet all of these soils would belong to the same class because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

### SOIL CLASSES

#### Soils Containing Less Than 20% Silt and Clay

1. Sand—Over 25% fine gravel, coarse and medium sand, and less than 50% fine sand.
   sand—Over 50% fine sand, or less than 25% fine gravel, and medium sand.

**Soils Containing Between 20–50% of Silt and Clay**

3. Sandy loam—Over 25% fine gravel, coarse and medium sand.
4. Fine sandy loam—Over 50% fine sand, or less than 25% fine gravel, coarse, and medium sand.

**Soils Containing More Than 50% of Silt and Clay**

5. Loam—Less than 20% clay, and less than 50% silt.
6. Silt loam—Less than 20% clay, and over 50% silt.
7. Clay loam—Between 20 and 30% clay, and less than 50% silt.
8. Clay—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a graduation in texture of otherwise uniform material, such a group is called a "soil series." It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for example, includes light colored, glacial soils, where the soils have been derived largely from the underlying limestone, and the soils in the series range in texture from a clay loam to sand and gravel with heavy types predominating. The Plainfield series includes light colored soils in regions where no limestone is present, and where the material occurs as outwash plains or stream terraces. The soils in this series also have a wide range in texture, but sandy types predominate. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil Survey.

By uniting the name of the soil class, which refers to texture, with the name of the soil series, which refers chiefly to origin, we get the soil *type*, which is the basis or unit of classifying and mapping soils. A soil type, thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and which has a distinct agricultural unity—that is, it is adapted to the same crops and requires the same treatment. It is also uniform in the source of material from which it is derived and the mode of origin, which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils and the basis upon which experimental work should be conducted, every farmer

should be familiar with the soil types on his farm, and their leading characteristics. It is sometimes necessary to show minor variations in types where a portion of the type is more stony than the rest, or less well drained, or has a steeper slope. Such minor portions are mapped as *phases*.

# SOIL SURVEY OF GREEN COUNTY

## CHAPTER I

## GENERAL DESCRIPTION OF AREA, CLIMATE, AND SOILS

Green County is in the extreme southern part of Wisconsin bordering the Wisconsin-Illinois boundary line. It comprises an area of 585 square miles or 374,400 acres. Monroe, the county seat, is 36.5 miles from Madison and 138 miles from Chicago.

### TOPOGRAPHY

Green County consists, topographically, of an undulating plain, the upland surface of which lies at an elevation of about 1,100 feet. The old elevated plain was level. The dissection or erosion has been carried so far that the watershed ridges are narrow and irregular. They are as a rule rounded and, where wide enough, have good soil on top. In the western part of the county the valleys are deeper and slopes steeper than in the eastern part of the area. The city of Monroe is located on a remnant of the old table land which covers a few square miles, the largest in the area. In a few other places the ridges widen to about one mile.

In the eastern part of the county, Sugar River has not only cut a valley into the plain but has, through the work of its lateral streams, developed a rather broad belt of undulating lowland on both sides of the stream. The surface of this lowland lies well above the level of the alluvial plain of the river, but is clearly the product of erosion. It extends along the main stream across the county, although tongues extend up the valleys to the tributary streams as blunt-

ended lowlands separated one from another by the projection of the upland inward along the watershed between the tributaries. Owing to the geological structures and stratigraphic character and succession of beds, the slope from the lowland to the upland is rapid in the upper part of the slope and more gradual below, merging imperceptibily into the undulating lowland.

Somewhat the same features have been developed along Little Sugar River and in places along Pecatonica River. The rest of the area, with the exception of a small part of the northeastern corner, consists merely of a well-dissected plain.

A small area in the northeastern corner of the county was run over by the ice sheet of the Wisconsin glacial period. Its relief is smoother than the rest of the region as a whole.

A special study was made of the land in two representative townships in the county: Decatur township, which represents the smoothest or least rolling land, and York township, typical of the roughest part of the county. The following table gives the classification and proportionate extent of each class of land in these townships and shows the effect of glaciation on the topography of the land:

CLASSIFICATION OF LAND IN YORK AND DECATUR TOWNSHIPS ON THE BASIS OF SURFACE RELIEF

| Class | Description | Proportionate extent | |
|---|---|---|---|
| | | York Township non-glaciated | Decatur Township glaciated |
| | | Per cent | Per cent |
| A | Level to gently undulating (including wet lands) | 8.0 | 53.0 |
| B | Undulating to gently rolling | 58.0 | 38.5 |
| C | Rolling to hilly | 25.0 | 5.5 |
| D | Steep, rough, and broken land,—mostly rough stony land | 9.0 | 3.0 |

Green County is entirely within the drainage basin of Rock River, and the county is well drained by Sugar and Pecatonica Rivers which come together in Illinois before entering Rock River near Rockton. The alluvial flood plains along the streams are the only poorly drained land.

## CLIMATE*

Nearly all of Green County is located within the southern highlands, one of the eight climatic provinces in Wisconsin. "Southern highlands" is a term used to include the rough or rolling region, mostly over 1,000 feet in elevation, which extends from Clark County south to the Illinois line and lies between the Mississippi Valley on the west and the Wisconsin and Rock River valleys on the east. It is characterized by a somewhat cooler temperature than the adjoining valleys, the summer temperature being similar to that along the Lake Michigan shore, and the mean winter temperature about 4° lower than along the Lake Michigan shore. The frost-free season, averaging 145 days, is apparently from 10 to 20 days shorter than on the lower land of the State in the same latitude; and in the river valleys and ravines in this region the frost danger is still greater, the records there showing an average frost-free period of 140 days. In some years corn fails to mature, and the use of land for pasturage and hay production is encouraged both by the surface relief and the heavier rainfall.

The mean annual temperature at Brodhead, as shown by the accompanying table, is 47.3° F. with an absolute maximum of 111° and a minimum of —33°. Although these temperatures are extreme, they are of very short duration and seldom occur. The average annual rainfall at Brodhead is 33.77 inches, and the average snowfall 33.4 inches. The prevailing winds are from the southwest. Rainfall is well distributed throughout the growing season when it is most needed.

The average date of the last killing frost in the spring is May 3, and the average date of the first in the fall is October 8. The latest recorded frost in spring occurred on May 25 and the earliest in the fall on September 11.

The following table, compiled from data of the Weather Bureau station at Brodhead, gives the normal monthly, seasonal, and annual temperature and precipitation at that place:

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* For further information on climate see Exp. Sta. Bulletin 223.

NORMAL MONTHLY, SEASONAL, AND ANNUAL TEMPERATURE AND PRECIPITATION AT BRODHEAD

(Elevation, 812 feet)

| Month | Temperature | | | Precipitation | | | |
|---|---|---|---|---|---|---|---|
| | Mean | Absolute maximum | Absolute minimum | Mean | Total amount for the driest year (1901) | Total amount for the wettest year (1907) | Snow, Average depth |
| | °F. | °F. | °F. | Inches | Inches | Inches | Inches |
| December | 23.1 | 62 | —26 | 1.55 | 1.16 | 1.23 | 7.9 |
| January | 19.0 | 60 | —33 | 1.44 | 1.47 | 3.13 | 8.4 |
| February | 19.4 | 56 | —31 | 1.56 | 1.30 | .40 | 8.0 |
| Winter | 20.5 | 62 | —33 | 4.55 | 3.93 | 4.76 | 24.3 |
| March | 34.6 | 84 | —13 | 2.33 | 2.83 | 2.13 | 5.4 |
| April | 47.5 | 89 | 15 | 2.91 | .75 | 3.61 | 1.9 |
| May | 59.0 | 95 | 24 | 4.11 | 2.89 | 2.64 | Trace |
| Spring | 47.0 | 95 | —13 | 9.35 | 6.47 | 8.38 | 7.3 |
| June | 67.8 | 103 | 34 | 3.95 | 1.43 | 4.71 | .0 |
| July | 73.4 | 111 | 40 | 4.04 | 3.83 | 9.37 | .0 |
| August | 70.8 | 103 | 35 | 3.46 | .46 | 4.21 | .0 |
| Summer | 70.7 | 111 | 34 | 11.45 | 5.72 | 18.29 | .0 |
| September | 63.3 | 100 | 20 | 4.09 | 3.30 | 7.83 | .0 |
| October | 51.9 | 87 | 15 | 2.49 | 1.57 | 1.25 | |
| November | 37.6 | 77 | — 4 | 1.84 | .83 | 1.38 | |
| Fall | 50.9 | | | | | | |
| Year | 47.3 | | | | | | |

## Soil Formations

Limestone and sandstone form the rock floor of Green County. The youngest and uppermost formation includes the Black River and Galena limestones which form the bedrock over most of the southern and western parts of the county. The two formations, being very similar, are usually spoken of together. A lower formation, St. Peter sandstone, predominates over most of the remainder of the county, giving rise to sandy soils in numerous places. The lower magnesian limestone, lying below this sandstone, is the uppermost rock formation in the vicinity of Sugar River, and it gives rise to heavier types of soil. All of these rocks have contributed to some extent to the soils of the region.

The eastern part—approximately half of county—is included within the area of pre-Wisconsin glacial drift. This dri[illegible] nd has not influenced the soils to as great an

extent as has the late Wisconsin glaciation in southeastern Wisconsin. The western part of the county is unglaciated and rough.

Soils of silt loam texture make up nearly 90 per cent of the land surface of Green County, exclusive of rough broken land and peat. Beneath the silty surface layer of the well drained upland soils is a layer of heavier material, usually silty clay loam, from 12 to 20 inches thick, beginning at from 8 to 15 inches below the surface. This subsoil layer is underlain by the partly weathered parent material, which in Green County may be either disintegrated limestone, sandstone, or glacial drift, or stratified, waterlaid deposits. This is the normal texture profile of this region and other regions which are similar in soil-forming agencies and processes.

The color of the surface soil over the well drained uplands is not so uniform as is the texture. In fact, two distinct soil groups, based on fundamental color differences, are represented in the county; one group is made up of comparatively light colored soils, and the other of dark colored soils, the dark color extending to depths ranging from 8 to 12 inches. These soils are intermingled throughout the county. Soils of the light colored group, represented by the Knox and Miami soils, and others of minor extent, are generally on the areas originally covered by forest; the dark colored soils, represented by the Dodgeville and Carrington series, are prairie soils. Poorly drained mineral soils are all very dark colored or nearly black. They total a considerable area, particularly in the eastern part of the county.

From the point of view of the origin of soil materials, there are at least six different kinds of soils in Green County—residual, loessial, glacial, alluvial, colluvial, and marsh. Some of the soil-forming material has been modified in various ways since it was first formed or deposited. In the soil survey of Green County, these soils have been classed into 13 soil series which include 24 soil types and 14 phases, exclusive of peat and rough broken land.

The Knox series includes light colored upland forested soils which have developed from material originating from the weathering of limestone. These soils have silty or

loesslike surface layers. Two soil types, Knox silt loam, with a deep phase and a steep phase, and Knox loam, with a steep phase, were mapped.

The Dodgeville series includes dark colored prairie soils developed from the same parent material as Knox soils. Two soil types, Dodgeville silt loam, with a deep phase and a steep phase, and Dodgeville fine sandy loam, with a steep phase, were mapped.

Boone soils are light colored soils usually of sandy texture, derived from the weathering of sandstone. Boone loam and Boone fine sandy loam, each with a steep phase, were mapped.

Carrington soils are dark colored prairie soils derived from calcareous glacial drift. Carrington silt loam, with a gravelly phase and a steep phase, was mapped in Green County.

The Miami series includes light colored upland forested soils derived from deeply leached calcareous glacial drift. Three members of this series were mapped: Miami silt loam, loam, with a steep phase, and fine sandy loam.

The Fox series includes light colored soils on terraces or outwash plains chiefly in the region of glacial drift. The material has all been reworked and redeposited by water but now exists above present overflow. The members mapped in Green County are silt loam, loam, fine sandy loam, and sandy loam.

Clyde soils are dark colored soils in poorly drained depressions on the glaciated upland. In places the series was extended to include some material which was water-laid. Two soil types, Clyde silt loam and Clyde loam, were mapped in this county.

The Waukesha series includes dark colored prairie soils on outwash plains or stream terraces well above present overflow. The parent material is water-laid. Four members of the series, Waukesha silt loam, fine sandy loam, sandy loam, and sand were mapped.

Wabash soils are dark colored, poorly drained first-bottom soils, subject to annual flooding. Two soil types, Wabash silt loam with a colluvial phase and Wabash loam, were mapped in Green County.

The Lintonia series includes light colored soils derived

from alluvial and colluvial material in the region where Knox soils form the higher-lying lands. These soils occur at the base of slopes, and the surface is level or only gently sloping toward the stream bed. They may also occur on terraces in the loessial country, in which case they correspond very closely to soils of the Fox series except that they are outside the glacial region. Lintonia silt loam was the only member of this series mapped in Green County.

Rough broken land includes steep, rough, broken, or extremely stony land which is practically non-agricultural. In some places it consists entirely of rock outcrops, but in other places there is considerable soil material although the surface is very steep.

The Plainfield series includes light colored sandy soils which occur on terraces or outwash plains. The parent material is largely sand. Plainfield sand is the only member mapped.

The Coloma series includes light colored upland soils whose parent material is glacial drift which has developed chiefly from sandstone. Coloma sand is the only soil of this series mapped in Green County.

The Rodman series includes the gravelly, stony glacial drift material which occurs chiefly as kames and eskers where the surface is very rough and where little soil has developed. Rodman gravelly loam is the only member of this series mapped.

Peat consists of vegetable matter in varying stages of decomposition with which small quantities of mineral matter have been mixed. Peat, with a shallow phase, was mapped in Green County.

The following table gives the acreage and proportionate extent of each soil type mapped in Green County:

ACREAGE AND PROPORTIONATE EXTENT OF TYPES OF SOIL

| Type of Soil | Acres | Per cent | Type of Soil | Acres | Per cent |
|---|---|---|---|---|---|
| Knox silt loam | 40,832 | | Fox loam | 3,776 | 1.0 |
| Deep phase | 45,248 | 31.1 | Waukesha fine sandy loam | 1,152 | .7 |
| Steep phase | 30,400 | | Fox fine sandy loam | 1,408 | |
| Knox loam | 3,008 | 1.0 | Waukesha sandy loam | 3,328 | 1.5 |
| Steep phase | 640 | | Fox sandy loam | 2,176 | |
| Dodgeville silt loam | 37,056 | | Waukesha sand | 1,216 | .3 |
| Deep phase | 57,024 | 30.0 | Clyde silt loam | 8,960 | 2.3 |
| Steep phase | 18,304 | | | | |
| Dodgeville fine sand loam | 1,984 | .7 | Clyde loam | 1,216 | .3 |
| Steep phase | 576 | | Waukesha silt loam | 6,848 | 1.8 |
| Boone loam | 3,776 | 1.2 | Wabash silt loam | 42,496 | 12.9 |
| Steep phase | 704 | | Better drained phase | 5,440 | |
| Boone fine sandy loam | 8,128 | 2.4 | Wabash loam | 1,344 | .3 |
| Steep phase | 896 | | Lintonia silt loam | 4,288 | 1.1 |
| Carrington silt loam | 5,888 | | Rough broken land | 14,336 | 3.8 |
| Gravelly phase | 576 | 1.8 | Plainfield sand | 1,024 | .3 |
| Steep phase | 128 | | Coloma sand | 192 | .1 |
| Miami fine sandy loam | 2,624 | .7 | Rodman gravelly loam | 256 | .1 |
| Miami loam | 4,352 | 1.3 | Peat | 4,672 | 1.4 |
| Steep phase | 384 | | Shallow phase | 640 | |
| Miami silt loam | 5,440 | 1.5 | | | |
| Fox silt loam | 1,664 | .4 | Total | 374,400 | |

# CHAPTER II

## SOIL IMPROVEMENT

### Part 1—CHEMICAL COMPOSITION AND IMPROVEMENT OF SILT LOAM SOILS

This group includes the Knox, Dodgeville, Carrington, Miami, Lintonia, Fox and Waukesha silt loams and their deep and steep phases.

These soils are quite similar in the texture and structure of the surface soil and in some cases in the upper portion of the subsoil as well. There are some marked differences in the character of the deep subsoil. The most marked difference in the group, however, is in color. The Carrington, Dodgeville and Waukesha soils are dark colored prairie types while the Knox, Miami, Lintonia and Fox soils are light colored timbered soils rather low in organic matter. The types of the group are sufficiently related in agricultural value, adaptation, etc., so that, with a few exceptions, methods for the improvement of one will apply to the others.

The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most likely to be deficient, are nitrogen, phosphorus, potassium, and lime or calcium. He should know the part which each plays in the development of the plant and the best methods for maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A five-ton crop of alfalfa requires one hundred and eighty-five pounds of lime, and two tons of red clover removes 61.6 pounds. A much larger amount is

removed by leaching each year, and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Failure of clover and alfalfa is in many places an indication of the need of lime. About 3 tons of ground limestone to the acre is the usual application on soils where alfalfa is to be grown, and 2 tons where clover is seeded. The amount to be used, however, may vary with the degree of acidity, the character of the soil, and the crop to be grown. Such crops as alfalfa, sweet clover, peas, cabbage, onions, and lettuce have a high lime requirement; clover, garden beans, barley, hemp, turnips, and radishes have a medium lime requirement; and vetch, white clover, oats, rye, bluegrass, potatoes, and sorgo (sweet sorghum) a low lime requirement. As a rule, heavy acid soils need more lime than sandy soils showing the same degree of acidity. Where a liberal supply of manure is available, the need for lime will not be so great. The second application which may be needed after six or seven years may be less than the first. The greater need will usually be on the higher places rather than on the lower slopes.

Ground limestone is doubtless the most economical form of lime for extensive use in Green County. Lime should be applied to plowed land in fall, winter, or spring, previous to planting, and thoroughly worked in by harrowing. Lime or manure spreaders may be used. An application of 3 tons of ground limestone for alfalfa or sweet clover and of two tons for other crops is sufficient for 8 or 10 years, after which two tons should be applied on the alfalfa land and one ton on other crops.

It has been quite definitely established that the need for lime in these soils runs practically parallel with the need for phosphorus. The use of lime alone will not make enough phosphorus available, and the use of a phosphate fertilizer will not supply the lime requirements of the soil. Either lime alone or acid phosphate alone will give increased yields, but neither alone will give as great an increase nor as profitable an increase as when both are supplied. In the improvement of these lands, therefore, provision for the use of both lime and a phosphate fertilizer should be made.

Phosphorus exists in all soils in Wisconsin in small amounts. Many of the best types in the state contain only 1,200 pounds to the acre eight inches deep, and this is in a form which becomes available to crops very slowly. Phosphorus is constantly being lost from the farm in crops, milk, and in the bones of animals sold. It is well understood that when grain, hay, potatoes or other cash crops are sold, this element is removed from the farm. Much phosphorus is also absorbed into the bones and flesh of animals and not returned to the soil, and there is some unavoidable loss from manure before it reaches the field. This element cannot be supplied from the air, and in the long run the loss must be made up through additions of phosphorus fertilizer in some form.

Thirteen samples of Dodgeville silt loam gave an average of 1466 pounds of phosphorus to the acre eight inches deep. Six samples of Carrington silt loam from Green County gave 1200 pounds per acre. Eight other samples of Dodgeville silt loam were found to contain an average of 1012 pounds per acre, and two samples of Waukesha silt loam contained an average of 1800 pounds per acre. In the light colored soils the amounts of phosphorus run somewhat lower. In twenty-two samples of Knox silt loam the average was 769 pounds, while in nine other samples of the Knox silt loam the average was only 640 pounds per acre. In eight samples of Miami silt loam the average supply of phosphorus was 805 pounds per acre eight inches deep. The number of pounds of phosphorus in the soil, however, cannot be taken to indicate the immediate need for phosphate fertilizer because its availability to crops varies. The system of farming followed, crops grown, type of soil, and conditions relative to acidity are all important factors in determining the need for phosphorus. It should also be borne in mind that where soils are acid, the amount of phosphorus which they do contain is not so readily available to plants as in soils which are not acid.

On good upland soil where dairying or general farming is practiced the use of 300 pounds of 20 per cent acid phosphate or 150 pounds of 45 per cent super-phosphate to the acre on each field every four or five years will maintain the

phosphorus supply. If much grain, potatoes, or other crops are sold, more phosphate should be used.

On the farm of Roy Marshall at Elkhorn in Walworth County, an application of one hundred pounds per acre of treble super-phosphate (45 per cent) on corn gave a yield of 15,570 pounds of silage while on the untreated plot the yield was 13,335 pounds per acre. In a test on the Miami silt loam soil on the Station Farm at Madison, a phosphate fertilizer applied at the rate of two hundred pounds per acre on oats gave a yield of 93.8 bushels, while the untreated yield was 70.4 bushels. This was on land where the fertility was quite high. In another case where 500 pounds of 16 per cent acid phosphate per acre was applied to prairie land which received both manure and limestone the yield of alfalfa was nearly doubled. The average of a large number of tests shows that the increase in yields due to phosphate has a value of three to four dollars for each dollar's worth of phosphate used. In some of these cases the increase is small, but it should be kept in mind that the fertilizer left over in the soil will be of considerable value to the following crop, especially clover and alfalfa.

On soils relatively low in fertility somewhat more phosphate should be used at first. This is especially true of the dark prairie soils which have grown corn or small grain a long time without the use of manure or other fertilizer.

If considerable amounts of bran or cottonseed meal are fed, which are relatively high in phosphorus, the supply of this element may be maintained. It would usually be necessary to feed at least one-half ton of bran or cottonseed meal to each cow on a dairy farm per year to maintain the phosphorus supply of the soil. Since comparatively few farmers do that, some phosphate fertilizer should be used.

## Application of Phosphates

Phosphate fertilizers not only increase the yield; they also have a special tendency to hasten the rate of maturity. For the latter reason they are especially helpful to corn in this state. In order to get the maximum benefit from the smallest expenditure for phosphate on corn, it should be applied near the hill where it will be

taken up early and more completely than when broadcast. The use of from 100 to 150 pounds of a phosphate alone, or of a mixed fertilizer high in phosphate, is being found very helpful in this respect. It must be recognized, however, that phosphate applied in that manner for corn will leave little that can be of benefit to small grain or hay following the corn. For these crops the fertilizer must be applied either with a grain drill having a fertilizer compartment known as a fertilizer grain drill, or broadcast with a broadcast sower and worked in when preparing for seeding. Since all legumes, such as clover and alfalfa which are relatively high in protein, require relatively large amounts of phosphorus, it is very important that these crops be supplied with this element, and the only way in which this can be accomplished is by broadcast application at the time of seeding the grain crop. It is possible, however, to apply the phosphate as a top dressing on clover or alfalfa. Good results are secured in this method when care is taken that the fertilizer is applied before much growth has taken place in the spring, or even better, after growth has stopped in the fall. It is especially important to avoid spreading the fertilizer when there is any moisture on the crop*

### POTASSIUM IN THE SOIL

Potassium exists in these soils in large amounts, but in relatively unavailable form. Chemical analyses show that they often contain from 30,000 to 40,000 pounds an acre eight inches, while these same soils will contain only one-eighteenth as much phosphorus. On most soils of fairly heavy texture, when livestock is maintained and the manure carefully used so that there will be considerable actively decomposing organic matter in the soil, a sufficient amount of potassium may become available from year to year to supply the needs of general farm crops. There are some crops such as potatoes, tobacco and cabbage that need relatively large amounts of potassium, and they will often be benefited by some addition of potash in the form of commercial fertilizer. It is also possible that alfalfa which

* For further information on the use of phosphates, see Experiment Station bulletins.

Fig. 1. Good pasture is the best and most economical summer feed for dairy cattle and it is the best means of prevention of erosion on steep hillsides. It requires fertilization to replace plant food removed by grazing.

Fig. 2. Brown Swiss cattle owned by dairymen of Swiss descent are quite at home in Green County.

needs large amounts of potash and does not get much manure will be benefited by potash in the fertilizer.

## NITROGEN IN THE SOIL

Nitrogen is chiefly responsible for the dark green, healthy color and rapid growth of corn or other crops on well manured land. It is important to have sufficient amounts in the soil, but when in excess it is detrimental for some crops. The quality of the grain may be injured by too much nitrogen. When in excess, it causes grain to lodge, and the kernels do not fully mature.

Virgin soils contain large amounts of nitrogen, but if they are cropped continuously to such crops as corn, oats, and timothy without the addition of fertilizer material containing nitrogen, the nitrogen supply is gradually exhausted, and the yields are reduced.

The supply of organic matter and nitrogen in the prairie soils is considerably higher than in the light colored timbered soils. Eight samples of Dodgeville silt loam from Green County showed an average of 4365 pounds of nitrogen in the surface eight inches. Two samples of Waukesha silt loam were found to contain 7,000 pounds each, and Carrington silt loam showed an average of 4,768 pounds for five samples. The light colored soils show a marked difference. Twenty-two samples of Knox silt loam contained an average of 2,690 pounds. Miami silt loam showed 3,572 pounds in an average of eight samples. A question of importance in connection with the nitrogen of this soil, however, is its availability to plants, and in the soils which have been under cultivation for a long number of years, this nitrogen is somewhat inert. When in this condition, decaying vegetable matter, green crops, or manure plowed under will give a more readily available supply of nitrogen.

The clover, alfalfa, peas, and beans have bacteria on their roots that take the free nitrogen from the air and store it in the plant roots. This is the cheapest method of obtaining nitrogen and one which the farmers should use to the fullest extent. On the ordinary dairy farm at least one-fourth of the land under cultivation should be in clover or alfalfa. This should be fed to stock or plowed under as

green manure to insure keeping up the supply of nitrogen and organic matter. When the manure from this feeding is properly handled, the nitrogen of the farm will be maintained.

Certain crops such as tobacco, potatoes, and vegetables are grown by farmers who do not keep much livestock and who do not rotate these crops with legumes. This is not a good practice. A rotation with a legume plowed under will secure nitrogen and reduce danger from diseases; and when supplemented with phosphorus and potassium fertilizers, the legumes thus treated will take the place of manure, which can then be used for other crops on the farm.

Some fertilizers contain only one of the plant food elements. Nitrate of soda or calcium and sulphate of ammonia contain nitrogen; acid phosphate and rock phosphates contain phosphorus; muriate of potash contains potash. Other fertilizers contain two or all three of the important elements. The composition of these fertilizers is indicated by a formula. A 3-10-4 fertilizer contains 3 per cent of nitrogen, 10 per cent of phosphoric acid and 4 per cent of potash. A 0-12-6 fertilizer contains no nitrogen, 12 per cent of phosphoric acid and 6 per cent of potash.

Where it is necessary to use commercial fertilizers which contain nitrogen, it is highly important that this fertilizer be applied with a fertilizer attachment on the planter, or in such manner that it will come within the root-feeding range of the plant. Fertilizer attachments are used in the application of fertilizers to potatoes and corn. For sugar beets the fertilizer should be applied at the time of planting with a regular fertilizer beet drill. Fertilizer for tobacco and cabbage is usually broadcasted previous to setting, although it has proved desirable to apply a small quantity with an attachment on the tobacco or cabbage setter, and to broadcast the rest after the crop has developed a more extensive root system. For onions and other truck crops, it is usually desirable to broadcast the fertilizer previous to planting.

Soils vary greatly in the total quantity of plant-food elements they contain in available form and especially in the proportion of the various elements required by crops. Sandy and light colored soils are generally low in most ele-

ments, especially potash. Light colored clay soils are comparatively low in nitrogen and are moderately well supplied with phosphates. Prairie soils are high in nitrogen but are usually acid and respond to phosphate fertilizer. Heavy soils contain potash in comparative abundance.

### Relation of Crops to Chemical Content of Soils

In the relation of crops to soils, the relative proportion of the different plant food elements required and the total quantity needed are deciding factors in fertilization. Although there are undoubtedly slight variations in the requirements of each individual crop, crops can be grouped fairly well into classes. Such crops as small grains and grasses, including timothy, require a comparatively large amount of phosphates and moderate amounts of potash and nitrogen. Such crops as corn, potatoes, tobacco, and sugar beets require large amounts of nitrogen and potash and moderate amounts of phosphate. Peas, clover, and alfalfa require large amounts of phosphate, potash, and lime, but under proper conditions they can secure most of their nitrogen from the air. The total quantity of plant food needed depends largely on the total weight of the crop produced.

### Use of Commercial Fertilizers

In determining the proper fertilizers to use, all of these factors must be considered. Commercial fertilizers should be used only to supplement the natural fertility of the soils, Acid phosphate should be used on the heavier soils in a system of general farming where a sufficient amount of manure is produced to cover the cultivated land every fourth year. From 125 to 350 pounds to the acre of this phosphate fertilizer should be used. It should be broadcasted or applied with a fertilizer grain drill at the time of seeding. If the soils are acid and in need of lime, this condition must be corrected before the phosphate fertilizer will be most effective.

Mixed fertilizer high in phosphoric acid may be used on lighter soils where there is a small supply of organic matter. From 200 to 400 pounds of these fertilizers to the acre may be applied with small grains. From 75 to 125

pounds an acre may be used on corn and should be applied with fertilizer attachments on the corn planter. Fertilizer applied to corn in this manner should only supplement the usual manurial treatment.

Mixed fertilizers high in potash may be used for truck crops where barnyard manure is not plentiful. It is imperative that some legume, such as clover or soy beans, be grown with these crops in order to supply the necessary amounts of organic matter and some of the nitrogen needed. For potatoes, from 400 to 1,000 pounds of fertilizer an acre should be applied, and for onions, cabbage, beets, and tobacco the fertilizer may be broadcasted at the rate of from 400 to 1,500 pounds to the acre.

Phosphate and potash mixtures should be used on the dark colored soils having no need for nitrogen in the fertilizer. For more specific information on the use of fertilizers, see bulletins of the Wisconsin Experiment Station.

## Permanent Pasture

Pasture crops require plant food the same as other crops grown on the farm. In fact, pasture should be considered in the same class as a cereal or hay crop as far as fertility requirements are concerned. Many of the permanent pasture plots have been grazed for many years with no thought given to the return of plant food removed by the dairy animals and other livestock maintained. The droppings of the animal in only a small way return plant food removed by grazing.

Where clovers make up a considerable part of the pasture crop, little thought needs to be given to the question of nitrogen fertilizers since the legumes can secure their nitrogen by fixation. Some of the recent work of the Experiment Station indicates that clovers may be established by seeding early in the spring before the frost is out of the ground, providing the supply of plant food is sufficient to meet the requirements of the crop. Alsike and white clover can be seeded when there is a very poor stand of grass and where it will catch. Quite frequently land so seeded may be utilized for pasture purposes the same fall, but it has been

found desirable to pasture late in the spring the first year after seeding in order that a good system may be established.

On soils which show a medium acid reaction, limestone is needed and should be applied at the rate of two tons to the acre. The fertilizer treatment should consist of a liberal application of phosphate, together with a moderate potash application. A fair treatment consists of 300 pounds of 20 per cent superphosphate together with about 100 pounds of muriate of potash. In case ready mixed goods are used, about 500 pounds of an 0–14–14 fertilizer per acre may be used. This fertilizer may be applied broadcast in late March or early April, at the time of the seeding if any is done, or without reseeding. The fertilizer and lime will greatly increase the growth of clover already on the ground.

On good pastures in this region from one and one-half to two acres will supply the feed for an average cow for five or six months, but it is usually necessary to supplement pasture crops a part of the time without overgrazing in order to maintain the herd in a thrifty condition and at maximum milk production. Where it is possible to secure five months' feed from the pasture land, it is quite apparent that this type of land may be very profitably utilized for producing dairy feed. The same is undoubtedly true if used for grazing beef cattle and sheep. Thus pasture economy is at once apparent when one considers that cost of pasture land is only for interest, taxes, and fencing, amounting to approximately $10.00 for the pasturing period, or $2.00 per month. On the other hand, the cost of feed during the winter period may range from $8.00 to $10.00 per month. Moderate steepness of slope is, therefore, not such a serious handicap, providing this land does not constitute a larger portion of the farm than can well be utilized for pasture purposes.

The majority of farms in the County, as at present laid out, include a fair amount of tillable land associated with rougher land adapted for pastures. In order that this steep land may be used to best advantage, livestock must be kept, and this is one of the principal reasons why the livestock industry is developed on such a large scale in Green

County. Livestock farming, it may be stated, is about the only type of agriculture that can fully utilize the steep land as well as the low, poorly drained areas. Dairying is, therefore, being developed on a large scale, as it is able to utilize land which in a grain system of farming would have little or no value.

## Soil Erosion

By hillside erosion is meant the removal by water of the more fertile part of the surface soil from fields which may have only a gentle slope. Not only are the soil particles removed, but the loss of the organic matter is of equal or greater importance.

Injurious washing due to hillside or sheet erosion may be controlled in a considerable measure by adopting proper cropping systems. Land subject to losses from this source should be kept as much as possible in grass, hay, or pasture and the ground devoted to cultivated crops as little as possible. Such crops as alfalfa may be grown, the crop left on the land continuously for a period of three to five years, followed by a cultivated crop, and then again reseeded.

It is also very desirable, wherever it is possible, to plow up only a section of the slope land, following the contour so that while the lower half, for example, is in cultivated crops, the upper half may remain in hay or pasture crops. Likewise, when the lower half is laid down to hay or grass, the upper section may be devoted to grain or cultivated crops. This practice has been followed by many farmers with good results.

Where there is any tendency for small gullies forming, these should be maintained in sod strips which protect the field from the flow of water during rains and prevent deep gullies which are sure to follow unless methods of protection are taken. These sod strips should be of sufficient width so that gullying does not begin at the side, resulting in two new gullies in place of the original one.

Increasing the supply of organic matter is one means of increasing the water-holding capacity of the soil, and thus of helping to prevent erosion. Plowing under of a green manuring crop, stable manure, and crop residues such as

straw and cornstalks, are processes that may be mentioned in this connection.

On much of the hillside land of this county which must be used for cultivated crops, the construction of terraces by the use of a plow and road grader will greatly lessen erosion. These terraces carry the water down the slope at a very low gradient so that it carries little silt or earthy matter with it and prevents the formation of gullies. Such terraces can be made on most of this land at an average expense of $1.50 to $2.00 per acre, which is very small compared to the benefit that it produces. They are broad and low so that farm machinery can be operated over the entire field as before.*

*Gullies.*—Erosion commonly leads to the formation of gullies unless prompt preventive measures are taken. Where these gullies are allowed to go unchecked, the entire field may soon be made practically useless for farming purposes.

It is, therefore, of the greatest importance that farmers in this region do everything possible to reduce and control losses from this source. Control measures include the prevention of the development of gullies in the early stages by filling in with brush, straw, or other material.

In many cases, gullies which have already been formed can be kept from further development through the construction of dams which will cause the accumulation of soil above them, yet will permit the water itself to continue down the slope. Different forms of dams have been used for this purpose. Under some conditions an earth dam may be satisfactorily used. In other cases a concrete dam is built but, in case of either the earth or the concrete dam, a tile sluice should be laid beneath the dam, extending down the gully so as to draw off the water above the dam before it reaches the top and carry it down a slope without permitting erosion losses.

Planting willows and brush on the sides and bottom of ditches too deep to fill often arrests the growth of the gully. Full information on the construction of dams will be found in the Experiment Station Bulletin on erosion.

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* For further information on the construction of terraces, see Experiment Station bulletin on erosion.

*Bottom land.*—Many of the bottom lands along the streams in the County are badly cut up because of the meandering tendency of streams. The straightening out of the stream bed in these bottom lands will be of some help. During periods of spring freshets or after any heavy rainfall, an enormous quantity of water collects in these valley bottoms, rendering control measures difficult. Were more of the steep slopes maintained in timber or forest growth, the runoff would be materially reduced, and the losses to the bottom land would be less destructive.

## Part 2—Chemical Composition and Improvement of Loams and Fine Sandy Loams

In this group of soils there are several types all of which are of minor importance individually, but collectively the group is important. These soils are somewhat lighter in texture than the silt loams but, where general farming is carried on, practically the same methods of improvement can be followed as outlined for the silt loam soils on page 19.

While there is some variation in the texture, structure, and color of the types of soil in this group, there is sufficient similarity so that general methods of improvement discussed here will apply to the entire group.

Tests and observations which have been made on these soils indicate that practically all of the types are in need of lime. The dark colored prairie soils show a greater need than the light colored soils. There are a few exceptions to this need and these are found where the underlying limestone comes close to the surface as it does in a few places in the western part of the county. Frequently, however, the soil will be in an acid condition even when the limestone is within one foot of the surface. See page 45.

The supply of organic matter in the dark colored types, such as the Waukesha and Dodgeville fine sandy loams, is somewhat greater than the light colored types, but in older cultivated soils this organic matter is in an active form so that the introduction of decaying vegetable matter will greatly aid in the improvement of these types regardless of color.

The supply of phosphorus in these loams and fine sandy loams is lower than in the heavier types, and these soils show a marked deficiency in this element. The actual number of pounds of phosphorus which these soils contain, however, is not a true index of the actual need of this element. Some of the soils which show a small total amount do not respond as well to an application of the phosphorus fertilizer as do the types which have a large amount present, so that the behavior of the crop is a more important indication of the need of phosphorus than the chemical analysis.

Regarding the supply of potassium in the soil, the total amount is approximately 25,000 pounds per acre, or fully 20 times as much as the supply of phosphorus. Where general farming is conducted, and where there is maintained a good supply of vegetable matter in the soil, this will doubtless be sufficient. Where special crops are raised which require a large amount of potassium, this element may be supplied to advantage in the form of a commercial fertilizer.

Where general farming is practiced, the fertilizer recommendations for phosphorus and potassium given for the group of heavy soils should be followed. See page 22.

The principal characteristics of these types are that they hold somewhat less water than heavier soils do, and they warm up more quickly in the spring. This, together with the readiness with which they can be worked, adapts them to truck and special crops, the growing of which requires more hand labor than is involved in the growing of staple crops. In growing truck and special crops it is necessary to give these soils somewhat more attention to maintain fertility, partly because of the fact that they are lower in fertility than the heavier soils, but more especially because these special crops require a higher degree of fertility to produce satisfactory yields. When these soils are used for the production of special crops, their fertility can be maintained either through the use of somewhat heavy applications of stable manure or through the use of a rotation in which a legume is grown as the means of securing the necessary nitrogen and organic matter, while the other elements, chiefly phosphorus and potassium, are supplied in commercial fertilizers. When this latter system is fol-

lowed, one-third or one-fourth of the land should be sown to a legume such as clover or soy beans which have large powers of gathering nitrogen from the air, and a part of the phosphorus and potassium should be used for the growth of different green manuring crops. The fertility used in this way will become available for the succeeding crops through the decomposition of the legume when plowed under, and the remainder of the fertilizer to be used should be applied on this ground at the time of fitting it for the succeeding crops.* See pages 25, 26.

## Part 3—Chemical Composition and Improvement of Sandy Soils

This group includes the Waukesha and Fox sandy loams and the Waukesha, Plainfield, and Coloma sands. These soils are quite similar in the texture of surface soil and subsoil but differ somewhat in their color and mode of origin. The Waukesha sand is darker colored than the Coloma and Plainfield and contains somewhat more organic matter. Taken as a group, the supply of nitrogen and organic matter is less than half that found in the Dodgeville silt loam, and it is also considerably lower than the average for the light colored silt loams. The phosphorus supply is markedly lower than in the heavy soils and often falls below 500 pounds per acre. The potassium supply is from one-half to two-thirds that found in heavy soils.

While these sandy soils are low in plant food and have a lower agricultural value than the heavy soils for general farm crops, there are certain advantages which they possess. They are easy to cultivate, they warm up early in the spring, and as a rule they respond readily and profitably to the application of fertilizers.

In the improvement of these soils, the first step is to supply the lime which is needed. This will require about two tons of ground limestone per acre. This should be applied to a plowed field and disked or harrowed into the soil to insure thorough mixing and an intimate contact between the soil grains and the limestone.

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* For further information on fertilizers for special crops see Experiment Station Bulletin.

The management of these soils to maintain the fertility will depend to a considerable extent on the crops grown and on whether or not stock is maintained to which the produce of the farm is fed. When dairying or other livestock farming is practiced, it will be less difficult to maintain the supply of the essential elements of plant food,—that is, phosphorus, potassium and nitrogen. But even when stock is maintained, it is very probable that the moderate use of some form of phosphorus and potash fertilizers will be found profitable, and some means for increasing the organic matter in addition to the use of stable manure should be made use of as far as practicable. The growth of a crop of soy beans or clover, occasionally, to be plowed under as a green manuring crop, will be found very profitable in its effect on the succeeding crop of corn or grain.

The following fertilizer treatment for legumes and other general crops is recommended by the Experiment Station:

On light sandy soil with little or no livestock, the fertilizer should carry from two to four times as much potash as phosphoric acid, and it should be applied at a rate to supply about 75 pounds of *actual* potash per acre. Assuming the fertilizer to be used a 0–8–24, 300 pounds per acre would supply 72 pounds of *actual* potash.

On sandy loam soils without livestock, or on well managed light sandy dairy farms, a fertilizer with equal amounts of the two elements or up to twice as much potash as phosphoric acid, should be used and it should be applied at a rate to supply 50 to 75 pounds of *actual* potash. Rates should be gauged according to previous management. This fertilizer should carry 30 to 50 pounds of phosphoric acid. Two hundred fifty pounds of 0–20–20 would supply 50 pounds of each.

On the better sandy loam dairy farms, a fertilizer with one-half up to just as much potash as phosphoric acid may be used, and at rates supplying the needed amount of phosphoric acid, namely, 40 to 60 pounds per application. For example,—300 pounds, 0–16–8; 500 pounds, 0–12–12; etc.

Clear muriate of potash (50 per cent *actual* potash) and acid phosphates (16, 18, 20, 24 or 45 per cent phosphoric acid) may be used separately, or home mixed, and applied in amounts to meet the above recommendations.

When these soils are used for the growing of potatoes or other special crops to a considerable extent, clover or some other legume must be grown regularly in the rotation to maintain the nitrogen and organic matter, and part or all of this should be plowed under. It is often desirable to use some commercial fertilizer containing phosphorus and potassium in order to secure a good growth of clover, and there is little loss in so doing since a large part of the phosphorus and potassium applied to the soil for the clover becomes available to the succeeding crop through the decomposition of the organic matter. But another application should also be made for the special crop to get the largest yields.*

While the use of commercial fertilizers containing phosphorus and potassium is desirable in the management of these soils, it must not be considered that this is an indication that they have less value than heavier soils, which are relatively higher in these elements, for the growth of potatoes and other special crops.The fact that these soils become dry and warm early in the season makes them less subject to local frosts, and the finer tilth which they develop fits them especially well for the growth of potatoes and some other special crops since they are practically free from checking and cracking. The cost of the fertilizers is a comparatively small part of the total cost of growing these crops. Sandy loam soil is well adapted to the commercial growing of potatoes, and whenever possible the sandy loams should be selected for this crop in preference to sand types. A good rotation for the sandy loam soils consists of small grain, clover, potatoes, or corn. For further suggestions on the management of these soils and for information regarding source and use of fertilizers consult bulletins of the Experiment Station.

## Part 4—Chemical Composition and Improvement of Poorly Drained Soils

These soils are all low-lying and poorly drained. They are quite extensive as a whole, covering most of the bottom lands of the county. These lowlands have received the

* See Experiment Station Bulletin—Fertilizers for Special Crops.

wash of lime-bearing water from the uplands for centuries, and the types therefore contain more lime than most of the upland soils. They are seldom in need of lime, especially the Clyde soils.

The total supply of mineral plant food elements is large, and where the soil is typically developed, the elements are usually found to be well balanced. Over some areas, howver, the surface is somewhat mucky in character, and in these localities the supply of phosphorus and potash is relatively low. On the average, this soil contains approximately 10,000 pounds of nitrogen in the surface soil, about 2,000 pounds of phosphorus, and from 30,000 to 40,000 pounds of potassium. The most marked feature is the fact that the potassium in many cases is of low availability, and crops, especially corn, sometimes turn yellow at an early stage and make poor growth. This ordinarily develops in patches of from one to several acres in extent. In such cases the use of potash fertilizer is necessary to remedy this condition.

The phosphorus supply is usually ample for a number of years after drainage. Such land as this must be manured eventually, or commercial fertilizers containing phosphorus and potash must be used. There is relatively a much larger supply of nitrogen than phosphorus and potassium. For this reason it is good practice to use the manure on the upland soils which are deficient in nitrogen and apply mineral fertilizers to the low land when these are needed. In many cases where the soil is high in organic matter to the depth of a foot or less, a marked need of potassium is shown during the first few years of cropping. This need disappears later because, when the surface settles, deep plowing mixes some of the under soil high in potash with the surface soil.

The first step in the improvement of this group of soils is drainage, and when thorough drainage is established they will make some of the best corn land in the State. Fertilizing with phosphate and potash will greatly increase their productivity as pasture. Where the bottoms are large, diking to prevent overflow may be resorted to, but where the bottoms are narrow this expense would not be justified. In some cases the beds of the stream could be lowered, thus providing better drainage and insuring a good outlet for

tile drains. In the drainage and improvement of the larger areas of this class of land, the organization of drainage districts would be advisable, and in many cases absolutely necessary.

### Improvement of Peat Soils

At present only a very small proportion of the peat soil in Green County is improved. The actual value of marshland depends upon the crops which can be grown upon it, which, in turn depends on the extent of drainage and the danger from frosts. When only a main outlet and lateral drainage ditches have been installed, only hay can be safely grown. When tilled crops such as corn, cabbage, potatoes, or small grains, are to be grown, the drainage must be more certain, and on the greater portion of the marshlands this necessitates the installation of open lateral ditches or tile drains not more than 10 or 15 rods apart.

In the case of peat land underlain by sand, well constructed and sufficiently deep ditches from 40 to 80 rods apart will, in most cases, give adequate drainage. When the peat soil is underlain by silt or clay, however, ditches not more than 20 rods apart are necessary, and these must lower the water in the ditch to a point 4 or 5 feet below the surface during part of the growing period.

Marshlands are more subject to early fall and late spring frosts than are uplands, partly because of their low-lying situation, and partly because the loose, spongy nature of the peat soil prevents the heat of the sun from penetrating much below the surface. This looseness of the soil can be somewhat improved by the use of a heavy roller which compresses the soil and gives it better heat conductivity. This tendency to frost reduces somewhat the availability of marshland for tender crops, but in Green County potatoes and corn on marshlands are seldom injured by frost.

On marsh soils commercial fertilizers containing phosphorus and potassium are more satisfactory than stable manure. Lime is not needed. Of the staple crops, hay and corn are best suited to such land. Special crops such as cabbage, hemp, and sugar beets also do well, but these will require larger quantities of potash and phosphate fertilizers.

# CHAPTER III

## GROUP OF SILT LOAM SOILS

### Knox Silt Loam

Knox silt loam is a grayish-brown friable, smooth silt loam soil, from 6 to 10 inches deep, containing a small or moderate quantity of organic matter or humus. The upper subsoil is a yellowish-brown slightly heavy silt loam, grading into silty clay loam, 14 or 16 inches below the surface. With increasing depth the heavy subsoil usually becomes gritty with chert and small angular rock fragments, and at depths ranging from 18 to 24 inches, red gritty clay occurs resting on the bedrock of cherty limestone.

The texture and color of the surface soil are uniform, but there is considerable variation in the depth to the red clay and bedrock. In a few places on steep slopes, the surface soil has been eroded and the red clay exposed. In other places on ridge tops or nearly level areas, the depth to bedrock is much greater than usual. On some of the more shallow areas, chert fragments are present on the surface and through the soil mass, this condition being most common on slopes and ridge tops where erosion has removed part of the surface soil. Some outcrops of limestone bedrock occur, usually on the steepest slopes.

Knox silt loam is one of the most extensive and important types of soil in Green County. It occurs to some extent in nearly every township, although more than 90 per cent of it is in the western half of the county. It is the predominating soil in New Glarus and Jordan townships, and it occurs extensively in Washington, Monroe, Cadiz, Adams, and York townships. It is associated with soils of the Dodgeville series.

Small bodies of this land on ridge tops or plateaus are rolling or nearly level, but on the sides of ridge slopes and around the heads of drainage ways the surface becomes so

Fig. 3. Residual soil formed from limestone rock which it overlies. The surface soil is acid because of downward leaching of lime.

Fig. 4. A typical view on the rolling hills of Green County.

steep that it is subject to serious erosion. Most of the steep slopes have been mapped as a steep phase of the soil. Because of the slope the drainage is good, the texture of the soil is such that it retains moisture well, and crops seldom suffer from drought except during unusually long dry periods.

The native forest growth on this soil consisted chiefly of oak, with some hickory, elm, maple, basswood, ash, walnut, cherry, and hazel brush. Most of the timber has been removed from the gently sloping land, but on many of the steep slopes a forest growth still remains. The chief crops are hay, pasture grasses, small grains, and some corn.

## Knox Silt Loam, Deep Phase

The surface soil of Knox silt loam, deep phase, has an average depth of 12 inches where cultivated. It consists of smooth, light-brown or grayish-brown silt loam, containing only comparatively small quantities of organic matter. The subsoil is yellowish heavy silt loam, grading into silty clay loam at a depth of about 18 inches and continuing as such to depths of 30 or 36 inches, where reddish clay or clay loam is usually present. This clay may contain fragments of chert. Both the surface soil and upper subsoil are free from coarse sand, gravel, and stones, and the texture as a whole is uniform. The soil is slightly acid in places.

Variations in depth of the soil and in surface contour, rather than in texture, occur in the mapped areas of Knox silt loam, deep phase. In most places the surface soil and subsoil have a total depth of 3 or 4 feet, but there are places where the underlying residual material comes within 2 or 3 feet of the surface, and there are some small areas where it is within one foot of the surface. The underlying rock is usually limestone. Where sandstone is the underlying rock, as in some places, the deep subsoil is sandy, and sand is more or less mixed with the silt. In such places the fine sand becomes more abundant as bedrock is approached. In portions of the county the limestone is somewhat sandy, and thin clay or shale layers may be present in the sandstone. In either case, a sandy or gritty clay loam or clay might be formed by the decomposition or weathering of the

rock. Some patches of light colored silt loam are also included with mapped areas of this soil where the region has evidently been glaciated. A color variation occurs where this soil borders the darker Dodgeville silt loam. In such places both surface soil and subsoil have a darker color than usual.

Knox silt loam, deep phase, is an important soil in Green County, covering a total area of 70.7 square miles. It forms part of every township, the largest areas occurring in Spring Grove, Clarno, Cadiz, Decatur, and Washington townships. The phase is closely associated with Dodgeville silt loam and with typical Knox silt loam.

The surface of this land is for the most part gently rolling, and the areas occur chiefly on ridge tops and long gentle slopes. In places these ridges are less than three-quarters of a mile wide, whereas in other places areas of this soil are several square miles in extent. The natural drainage of this land is good.

The native forest growth on this phase of soil was similar to that on the typical soil. At present, the greater part of the land is under cultivation. The acreage of desirable cornland is somewhat small because of the danger of serious washing even on quite gentle slopes.

### KNOX SILT LOAM, STEEP PHASE

Knox silt loam, steep phase, is closely associated with typical silt loam, but it is not so extensive. The soil usually resembles the typical soil, but it is subject to greater variation and forms a thinner covering over the underlying rock. The surface soil is usually a light brown silt loam about 10 inches deep. This is underlain by a yellowish brown silty clay loam material which usually prevails to a depth of 3 feet or more. In many places, erosion has removed the surface covering, and the heavy silty clay loam material forms the surface soil. In other places, especially where the soil is shallow, rock fragments are present in the soil mass. Where the soil overlies sandstone, considerable fine sand is incorporated with the soil in many places, and the deep subsoil may consist of a fine sand or fine sandy loam. Where limestone is the underlying rock, the subsoil may be a red

or reddish-brown, heavy clay loam containing cherty fragments. Rock outcrops occur here and there on this soil.

The surface of this kind of land is rolling or hilly with steep slopes and sharp, narrow ridges where the danger from erosion is great. Because of the danger of erosion, not much corn is grown on the steep land. It is grown mostly on the gently rolling ridge tops and lower slopes below the steep land, and the steep slopes are utilized mostly for permanent pasture and for wood lots. Much of this land is in permanent pasture, the steep slopes producing grass of excellent quality for dairy cattle. Alfalfa also is grown, usually in the shallow soils on ridge tops where roots can readily penetrate to the lime-bearing subsoil.

The original forest growth consisted of maple, hickory, birch, basswood, and several varieties of oak. Only a small part of this soil is under cultivation. Most of it remains forested although where the timber has been partly or completely removed the land is generally in permanent pasture.

### DODGEVILLE SILT LOAM

The surface soil of Dodgeville silt loam is from 6 to 10 inches deep. It consists of a dark brown or almost black silt loam with a high content of organic matter. Quantities of fine sand are present in the surface soil in places, and small fragments of chert are common. The upper part of the subsoil is a heavy silt loam, considerably lighter in color than the surface soil, and at a depth of about 16 inches this grades into a reddish-brown clay loam containing numerous chert fragments, which become more numerous with increasing depth. This is underlain by heavy clay loam or clay. The usual depth to bedrock ranges from 2 to 3 feet, although outcrops of bedrock along the slopes are numerous. Within a few inches of the underlying rock, which is limestone, the color is variegated. Many small pockets of sand occur in the subsoil, and in a few small areas the surface material is a fine sandy loam. Such areas usually occur on the slopes, but many are too small to be indicated on the soil map.

Dodgeville silt loam, with its deep and steep phases, is the second most extensive soil and probably the most impor-

tant in the county. Some of this soil is present in every township; it is the predominating soil in Jefferson, Sylvester, Monroe, York, and Adams townships. It is closely associated in many places with Knox silt loam and differs chiefly from that soil in the color of the surface soil and the content of organic matter.

The surface of areas of Dodgeville silt loam ranges from gently undulating to rolling. The undulating areas occur as ridge tops, and the rolling surfaces are found where streams have worked back into the land, carving valleys and leaving ridges, along the slopes of which rock outcrops are numerous. The natural drainage is well established; it is even excessive where the soil is shallow. On the steeper slopes some erosion occurs.

This soil is derived from the weathering of the underlying limestone, and its dark color is doubtless due to the decay of a rank growth of grasses under moist conditions. Dodgeville silt loam is a prairie soil, and the original vegetation consisted chiefly of prairie grasses, with only a scattered growth of trees along some of the slopes and bordering forested soils.

Probably about 65 per cent of this soil is under cultivation, the remainder being used chiefly as permanent pasture. The type of agriculture most extensively followed consists of general farming and dairying. The chief crops are oats, barley, wheat, clover, and timothy. The rotation most commonly followed consists of corn, which may be grown for two or three years, followed by a small grain crop possibly for two or three years, after which the land is seeded to timothy and clover and cut for hay for at least two years. Many farmers pasture the fields for a year or more before again plowing them for corn. Better results are obtained by reducing the length of the rotation.

The acreage of alfalfa is gradually increasing, and this crop does well where the soil contains plenty of lime. The application of ground limestone is necessary in many places for success with this crop. In fact much of this soil is acid and is benefited by the use of lime. The use of a phosphate fertilizer on alfalfa is also very important.

* See Experiment Station bulletin, "Liming Wisconsin Soils"

## DODGEVILLE SILT LOAM, DEEP PHASE

The surface soil of Dodgeville silt loam, deep phase, consists of a very dark brown or almost black friable silt loam, from 8 to 14 inches deep, with a somewhat high content of organic matter. The surface of the soil is free from coarse sand, gravel, and stones, and the texture is uniform. The subsoil consists of a yellowish-brown heavy silt loam which grades into a silty clay loam or clay loam at a depth of about 20 inches. Below this depth the color in many places is a more pronounced yellow, or the subsoil may be a reddish-brown or red clay resting on limestone 3 or 4 feet below the surface. Where the soil section is deep, the yellow color usually prevails, and where the soil mass is less than 3 feet deep, a reddish color is more likely to occur. The soil phase is developed most extensively on undulating ridge tops and on long gentle slopes.

Although Dodgeville silt loam, deep phase, is generally uniform throughout most of its extent, a number of variations were noted. The most marked of these is the difference in the depth of the surface soil and the depth of the soil mass to the underlying rock. The deepest dark brown surface soil occurs on the smooth ridge tops and along gentle slopes, and on some lower slopes there are small areas where wash from the higher lands has accumulated. The dark soil is shallower on the more pronounced slopes, and the red or yellow clay comes nearer to the surface. Along narrow ridge tops and on some of the steeper slopes where the soil is not so deep as typical, chert fragments occur on the surface and in the soil. In the eastern half of the county, a few glacial bowlders may be present on the surface, and in isolated tracts limestone fragments may occur.

Accompanying these variations in the depth of the soil there is also a variation in the degree of acidity. On the ridge tops where the surface soil is deepest a medium degree of acidity usually prevails, and even where the limestone comes close to the surface an acid condition may exist. The least acidity is usually found on steep places where the heavy limey subsoil is exposed, and on lower slopes where the soil receives wash from limestone ledges above.

The surface is gently undulating or rolling, usually ap-

pearing as gently rolling prairie land. Natural drainage is well established, although on some of the more gentle slopes it is probable that tile drainage might be advantageous. On the steeper slopes some damage from erosion has taken place, but this can be checked by care in cultivation and in the selection of crops.

Dodgeville silt loam, deep phase, like typical Dodgeville silt loam, is derived mainly from the weathering of the underlying limestone. On some of the hillsides the surface material has been removed by erosion, and the reddish, residual material usually lying just above the limestone is exposed. This material is also seen in many road cuts. The small area of this soil, mapped in the south-central part of the county where the pre-Wisconsin glacial drift is present, may differ slightly in origin from the other bodies because it is partly derived from glacial drift. But the old glacial drift is very thin, and the soil is practically the same as in the driftless area. A few crystalline bowlders occur in this region, and their presence is usually the only indication of glacial action.

Dodgeville silt loam, deep phase, is a prairie soil, and the native growth consisted chiefly of prairie grasses. There are some trees, as oak, hickory, basswood, and some maple on some of the steeper slopes and along the edges of other kinds of land. Hazel brush is abundant in places. Probably about 90 per cent of this soil is in cultivation, and the remainder is in permanent pasture. The same crops are grown, and about the same rotations followed, as on the typical soil. Less steep land is included in the deep phase than in the typical soil; consequently less erosion has taken place and the average value is higher.

## DODGEVILLE SILT LOAM, STEEP PHASE

The steep phase of the Dodgeville silt loam occurs in small, usually narrow and irregular areas which are so steeply sloping that the land is not adapted to cultivated crops and is largely in pasture. Slopes of 10 or 15 per cent are subject to erosion when cultivated.

The soil of the steep phase of Dodgeville silt loam is essentially like the typical soil, except where erosion has car-

ried away the surface silty layer and exposed the heavier subsoil. On uneroded areas the surface silty soil may be thinner than is typical, and the total depth of weathered material over the bedrock may be less.

The steep phase soil is associated with typical Dodgeville silt loam throughout its distribution in the county. The individual bodies are small but numerous, and the total area is 28.6 square miles.

### Carrington Silt Loam

The surface soil of Carrington silt loam consists of a dark brown or almost black, friable silt loam, comparatively high in organic matter. It usually contains some fine sand, and in many places a small quantity of gravel. Tests indicate that the surface soil is acid. The subsoil consists of a somewhat friable, dingy-brown silt loam material which grades downward into yellowish-brown silty clay loam material containing some fine sand and gravel. At a depth of 20 or 30 inches a sandy clay or a sandy loam material occurs. The deep subsoil usually grades into glacial till, composed of mixed clay, sand, gravel, and bowlders. In some areas where the limestone bedrock is within 4 feet of the surface, the lower subsoil is a reddish-brown clay, carrying fragments of the weathered limestone from which it originated. In places, limestone fragments occur in both soil and subsoil.

Where this soil borders Knox silt loam or Miami silt loam, it is lighter in color and lower in organic matter than elsewhere; and where it borders fine sandy loam soils, both soil and subsoil contain more fine sand. On some of the steep slopes the soil has been removed by erosion and the underlying till exposed, and in other places the clay loam subsoil comes to the surface. The soil, as mapped, includes small areas of Carrington loam and fine sandy loam. This soil is similar to Dodgeville silt loam, but it differs from that soil chiefly in being underlain by glacial till.

Carrington silt loam is not so extensive in Green County as Dodgeville silt loam, but it is widely distributed, occurring chiefly in Brooklyn township in the northeastern corner of the county and in Clarno township in the south-cen-

tral part, both areas lying within the glacial region where the Carrington soils are developed. The surface of these areas varies from gently rolling to hilly, the surface features having been developed almost entirely by erosion. On account of the sloping surface and the open nature of the soil and subsoil, the natural drainage is good.

Carrington silt loam comprises prairie soils developed principally on glacial drift. The pre-Wisconsin glaciation is evident in this region, but the amount of glacial till within this old glacial belt is small, and in many places it seems to be lacking. In such places soil types representing the residual material are mapped, and it is evident that some of the material included with Carrington silt loam is also of residual origin from the underlying limestone. In some places the surface soil is developed on glacial drift, and the subsoil is residual material derived from limestone. Frequently, the boundary between areas of Carrington and Knox soils is difficult to establish as the change from one soil to the other is not marked. The parent glacial material is the distinguishing feature of the Carrington soils, and a heavy red substratum is usually an indication of residual material.

Probably 80 per cent of Carrington silt loam land is under cultivation, the remainder being devoted to permanent pasture. General farming is practiced in conjunction with dairying. This is prairie soil, and the native growth consisted almost exclusively of prairie grasses. Corn, oats, barley, and hay are grown successfully on this soil, and it is handled and fertilized in the same way as Dodgeville silt loam.

## CARRINGTON SILT LOAM, GRAVELLY PHASE

The surface soil of Carrington silt loam, gravelly phase, consists of a dark brown or black fine sandy loam, loam, or silt loam which prevails to a depth between 8 and 12 inches. A small amount of gravel is usually present on the surface. The yellowish-brown or chocolate-brown loam subsoil grades through gritty clay loam into gravelly sandy loam. In a few places a gravel bed occurs within 3 feet of the surface and may even be exposed at the surface, whereas in

other places the soil is nearly free from gravel. The parent material is largely calcareous glacial drift.

This gravelly soil is very inextensive and therefore of minor importance. Most of it is associated with Carrington silt loam although in some places it is associated with Dodgeville silt loam, the gravel ridges being all that give evidence of the old glaciation, whereas the surrounding soils appear to be residual. The gravelly phase of this soil occurs in Clarno, Monroe, Decatur, and Albany townships.

Carrington silt loam, gravelly phase, occurs chiefly in long, narrow ridges, and in isolated gravelly hills. The natural drainage is good or even excessive. Because of its small total area, the soil is of little agricultural importance. Some of it is well suited to alfalfa because it is well supplied with lime. Although the subsoil may be high in lime, however, the surface soil is sometimes so acid that liming may be necessary in growing clover or alfalfa. The chief crops grown are corn, oats, barley, and hay, and the uncultivated portion of the land is mostly in permanent pasture. Crop yields are fair, although inferior to those on Carrington silt loam.

### Carrington Silt Loam, Steep Phase

A very small total area of Carrington silt loam is indicated on the soil map as a steep phase. It differs primarily from the typical soil in its steeply sloping surfaces which restrict the usual farming practices and render the land better adapted to pasture than to cultivated crops.

### Miami Silt Loam

The surface soil of Miami silt loam consists of a grayish-brown silt loam, 8 or 10 inches deep, low in organic matter because it was originally wooded. The upper subsoil is yellowish-brown heavy silt loam material grading into silty clay loam, which at a depth of 18 or 20 inches is usually underlain by brown gritty clay loam or clay. In many places this material contains some rounded gravel; it may also carry some chert fragments. A small amount of gravel and some glacial bowlders may be present upon the surface, especially on the knolls and steeper slopes. The soil is variable and in many places contains fine sand.

Miami silt loam is confined to the glaciated part of the county, the largest tract occurring in Albany township and in the adjoining part of Decatur township. Other small patches are in Brooklyn, Mount Pleasant, Sylvester, and Clarno townships. This soil is closely associated with Knox silt loam and closely resembles that soil type. The chief difference is the presence of drift, stone, and gravel in the Miami soil.

The surface of this land ranges from nearly level to rolling, and the natural drainage is usually good although it may be slightly deficient near low places where the surface is nearly level.

Miami silt loam is derived from calcareous glacial debris from the pre-Wisconsin or early Wisconsin ice sheet, and the deposit in Green County is very thin. The parent material is entirely lacking in many places, and elsewhere the glacial material has become so mixed with residual material that it is difficult to distinguish which material predominates. The old till has been thoroughly leached, and in most places an acid condition prevails in the surface soil.

The native forest growth was chiefly of oak, basswood, and maple, with some hickory, elm, and ash. Practically all merchantable timber has been cut, and most of the land is in improved farms. The chief crops grown are corn, oats, barley, timothy and clover, and some alfalfa. The soil is of similar agricultural value to Knox silt loam, and the same farming practices and methods of improvement apply to both.

## Fox Silt Loam

The surface soil of Fox silt loam consists of light-brown or grayish-brown silt loam from 8 to 12 inches deep, which, owing to its very low content of organic matter, has a whitish appearance when dry. The material is almost free from sand and gravel and has an extremely smooth feel. The upper subsoil is brownish-yellow silt loam, grading at depths of 16 or 20 inches into yellow silty clay loam which may continue to a depth of 3 feet or more. In many places a silty fine sandy loam is encountered between depths of 2 and 3 feet. It is underlain by stratified beds of sand or gravel.

This soil is not extensive and occurs chiefly in the valley of Sugar River in the eastern part of the county. A few scattered areas occur elsewhere, but they are practically all within the region covered by the ice sheet.

The surface is level or very gently undulating, and the natural drainage is sufficient except where the underlying beds of sand and gravel are 3 feet or more below the surface. In many places bordering areas of Clyde soils, the drainage is deficient.

The original forest growth consisted of oak, elm, hickory, and some ash, but practically all of this land is now cleared and forms parts of highly improved farms. The chief crops grown are corn, oats, barley and hay. The same systems of farming and cultural methods are followed as on Miami silt loam and Knox silt loam, and the soil has about the same degree of productiveness.

### WAUKESHA SILT LOAM

The topsoil of Waukesha silt loam is about 12 inches in depth. It consists of a black velvety silt loam containing a high percentage of organic matter. The upper part of the subsoil is chocolate-brown heavy silt loam or silty clay loam material which gradually becomes yellowish-brown with increasing depth. Below a depth of 24 inches the subsoil in many places is clay loam material slightly mottled; elsewhere the subsoil contains some fine sand. At depths ranging from 2 to 5 feet stratified beds of sand and gravel are present, the depth to the coarse material usually being more than three feet. The surface soil is quite uniform and is free from gravel, stones, and bowlders.

This is an important soil in the county, but it is not so extensive as other black prairie soils. It is most extensively developed in the eastern part of the county in the valley of Sugar River and its tributaries, although it may occur in small patches along any of the watercourses within the county. Some of the most important bodies are in Decatur and Spring Grove townships on what is known as Jordan Prairie. Others are Sylvester, Exeter, and Mount Pleasant townships, as well as in other localities.

The surface of this land is level or very gently undulating

and the natural drainage is fair or good, except that, where the surface is flat or slightly depressed and where the depth to sand and gravel is 3 or 4 feet, the drainage is somewhat deficient. Waukesha silt loam occurs chiefly on terraces or outwash plains, the material doubtless having been worked over by ice action and carried out from the front of the ice sheet by water. This debris was deposited in the flood plain of glacial streams, constituting the parent material from which this and several other soils of the county have developed. It is certain that the stratified portion was deposited as indicated above, but the extremely silty covering forming the surface soil and part of the subsoil may be of different origin, since it has some of the characteristics of wind-blown or loessial material. The dark color is due to the growth and decay of a rank grass vegetation. The surface soil is acid. This is a prairie soil, and the native growth consisted chiefly of grasses.

Waukesha silt loam is the highest-priced farm land in the county. It is practically all tillable and is all in well-improved farms, devoted to general farming and dairying. Corn, oats, barley, and hay are the principal crops, corn having the largest acreage. Some wheat also is grown.

Although this is highly productive land, it can be improved for growing clover and alfalfa by the use of lime. The soil also responds to the use of phosphate fertilizers.

## LINTONIA SILT LOAM

The surface soil of Lintonia silt loam, to a depth of about 10 inches, consists of brownish-gray, friable silt loam which becomes lighter in color when dry and frequently has a whitish appearance. The quantity of organic matter present in the surface soil is comparatively small and accounts in part for the light color of the soil. A slightly acid condition has developed in places in the topsoil. The subsoil consists of yellowish-brown or buff-colored material having a silt loam texture. This usually becomes somewhat heavier and more compact with depth, and at depths between 24 and 30 inches it may grade into a silty clay loam. Below a depth of 3 feet considerable stratified sandy material containing some gravel exists, and it may prevail to depths

varying from 4 to 6 feet. The depth to this sandy material varies between 2 and 6 feet but averages about 3 feet. This soil closely resembles Knox silt loam in texture, structure, and color to a depth of 3 feet.

Lintonia silt loam occurs in several parts of the county but is confined chiefly to the valley of Sugar River. The largest tracts are in Clarno, Decatur, Brooklyn, Albany, Exeter, and Cadiz townships. The soil is developed on stream terraces, and the surface is for the most part level or has a gentle slope toward the stream along which it occurs. It frequently occurs on narrow benches, varying in width from a few rods to one-half mile, between the bottom land subject to overflow and the steep slopes forming the valley walls. The terraces are above present flood plains, and the natural drainage is usually fair or good. However, in places where the depth to sand is more than 3 feet and the surface level, the natural drainage may be deficient. Gullies and ravines have been cut across the terraces by water rushing down the valley slopes. The material composing Lintonia silt loam is largely of alluvial origin, although it is probable that the surface material, especially close to the foot of the bluffs, is partly colluvial, having been washed down the steep slopes from areas of Knox silt loam lying at higher elevations.

Although the surface soil is slightly acid in places, the land nearest the bluffs is slightly calcareous, especially where it occurs adjacent to uplands underlain by limestone from which there is a wash.

Most of the original timber has been cut, and this land is practically all highly improved and very desirable. It is devoted to general farming and dairying, as is Knox silt loam. The same crops are grown, and about the same yields are secured as on Knox silt loam. The same methods of improvement regarding fertilization and rotation will apply to both soils. Lintonia silt loam is of slightly higher value than Knox silt loam land.

## ROUGH BROKEN LAND

Rough broken land includes rock exposures, cliffs, and land which is too steep and rough to plow or cultivate. It

may be considered non-agricultural, and it is of value only for the small quantity of timber and pasturage it supplies.

This land occupies many of the steep walls bordering the valleys and forms a border between the valley bottoms and the high land of the ridges. It is developed in narrow bands, many miles in extent, winding in and out with the valleys and coves, but it is confined to the steep slopes. A part of it occurs as narrow ridges upon which are areas of arable land too small to be mapped. The bluffs and cliffs are highest along the western border of the county, and many of them attain an elevation of 200 or 300 feet above the valley bottoms.

Rough broken land is quite uniformly distributed throughout the central and western parts of the county; it is intimately associated with Knox silt loam and with the Boone soils. The greater part of the rock consists of St. Peter sandstone, Black River limestone, and Galena dolomite.

The remaining forest growth consists of white oak, red oak, pine, and hickory, with considerable undergrowth and brush in places.

# CHAPTER IV

## GROUP OF LOAMS AND FINE SANDY LOAMS

### KNOX LOAM

Knox loam consists of grayish fine sandy loam or loam, 8 or 10 inches deep, underlain by yellowish or reddish-brown sandy clay loam which prevails to depths ranging from 18 to 24 inches and becomes very sticky at depths of 30 or 32 inches. This is underlain by disintegrated limestone. The texture of the soil and subsoil is variable, although consistently lighter than that of Knox silt loam. This soil occurs chiefly in Jordan and Cadiz townships, although other small tracts, too small to be shown on the soil map, are present in other parts of the county. This type of soil, with its steep phase, covers a total area of 3,648 acres.

The surface contour of this land is similar to that of Knox silt loam; it has the same native vegetation, is farmed in about the same way, and has practically the same agricultural value.

### KNOX LOAM, STEEP PHASE

A steep phase of Knox loam is mapped where areas are so steep that ordinary agricultural practices are difficult. Only a few small patches in the western and southwestern parts of the county are mapped. Land of this kind has a lower value than typical Knox loam, and most of it is left in forest or used as pasture.

### DODGEVILLE FINE SANDY LOAM

The surface soil of Dodgeville fine sandy loam is a dark-brown, or almost black, fine sandy loam or loam about 10 inches deep. The soil is acid and high in organic matter. In places, a small quantity of gravel and some limestone and chert fragments are scattered over the surface and mixed with the soil. The upper subsoil is usually a yellowish-

brown fine sandy loam, grading at depths of 16 or 20 inches into a sandy clay loam or sandy clay, which prevails to a depth of 3 feet or more; but in many places the underlying limestone is within 3 feet of the surface and is immediately covered by 4 or 6 inches of reddish-brown, rather plastic sandy clay containing particles of decomposed limestone. Both soil and subsoil are subject to numerous variations.

This soil is of small extent in the county but is widely distributed. It occurs principally in Adams, Sylvester, Clarno, Washington, and Cadiz townships.

The surface of this soil is rolling, but the slopes are not steep. Because of the loose, porous nature of the subsoil and the broken underlying rock, the natural drainage is excellent or even excessive. This condition also prevails where the limestone occurs near the surface.

This soil is largely residual from the underlying limestone, and in some places this rock is so sandy that it imparts a sandy texture to the soil material. Part of this soil occurs within the region which was glaciated, but the influence of the ice-laid material on the soils is slight although some ice-deposited granitic bowlders and some gravel occur.

This is a prairie soil, and the natural vegetation included only a few scattered trees and prairie grasses. About 80 per cent of this soil is under cultivation and devoted to general farming. It is considered a fair soil, and it is easy to work, but it is not equal in productiveness to Dodgeville silt loam. The general farm crops common to the region are grown, potatoes being grown more extensively than on the heavier soils of the county. The acid condition of the soil in many places causes failures with clover and alfalfa.

### DODGEVILLE FINE SANDY LOAM, STEEP PHASE

Areas of Dodgeville fine sandy loam which are so steep as to be especially susceptible to erosion when cultivated are indicated on the soil map as the steep phase. They are small and irregular in shape, occurring on the steeper valley slopes in association with typical Dodgeville fine sandy loam in the western part of the county. The total area is less than one square mile.

## BOONE LOAM

The surface soil of Boone loam has a depth of about 10 inches. It consists of a light brown or grayish-brown loam, having a comparatively low content of organic matter. It is underlain by a lighter colored loam or fine sandy loam which gradually becomes heavier with depth and grades into a sandy clay about 2 feet below the surface. This heavy subsoil may continue to a depth of 3 feet or more where it rests on bedrock; or it may grade into a fine sandy loam or fine sand where the bedrock is less than 3 feet below the surface. Immediately over the rock the subsoil, in many places, has a mottled reddish color. The soil is variable in texture, and the surface soil is generally acid.

This soil is of small extent but widely distributed. It occurs in Adams, Albany, Cadiz, Jordan, Exeter, and Washington townships, as well as in some other parts of the county. It occurs mostly on lower slopes below outcrops of sandstone rock.

The surface is rolling, and there is some danger of erosion on the steepest slopes. The natural drainage is good, or even excessive, where the rock is near the surface.

This soil is derived largely from the underlying limestone and sandstone rock formations. The sandstone has contributed most largely to its formation.

The natural forest growth consisted of hickory, basswood, birch, some poplar, and several varieties of oak. The merchantable timber has been removed, but a large part of the land is still uncleared.

About one-third of this soil is under cultivation, largely for general farming similar to that on Knox silt loam with which it is frequently associated. Corn, oats, barley, and hay are the chief crops grown. The methods of cultivation, crop rotation, and fertilization followed are practically the same as on Knox silt loam, and this soil responds to the same treatment.

## BOONE LOAM, STEEP PHASE

The steep phase of Boone loam includes those areas on slopes which are too steep for cultivation under present ag-

ricultural methods. The bodies are small and are associated with typical Boone loam, chiefly in the western part of the county.

At present the land is utilized for pasture or is forested.

### BOONE FINE SANDY LOAM

The surface soil of Boone fine sandy loam, 8 or 10 inches deep, consists of a light brown or brown fine sand or fine sandy loam, very low in organic matter and somewhat acid. The subsoil is a yellow fine sandy loam which becomes heavier with depth; and at a depth of 20 or 24 inches it is a yellow sandy clay which continues to a depth of 3 or more feet. Fragments of sandstone are present in places in both soil and subsoil. In some places, especially near the base of slopes, the surface soil is underlain by a layer of yellow fine sand which may continue to a depth of 24 or 30 inches before the yellow fine sandy loam is encountered. On the slopes immediately below sandstone outcrops, irregular fragments of sandstone are scattered over the surface and mixed with the soil in sufficient quantities to hinder cultivation.

This soil is rather inextensive, but the bodies are widely distributed, occurring in at least half of the townships of the county. Probably the largest body is in Albany township directly west of the village of Albany and extends along the south side of Little Sugar River for a distance of several miles. Boone fine sandy loam, together with its steep phase, covers a total area of 14.1 square miles.

The surface of this soil is nearly level along the lower slopes and steep and broken on the ridge tops and hillsides, the larger areas on the steep slopes being mapped as the steep phase. It usually occurs on lower slopes below outcrops of sandstone or low secondary ridges from which the capping of limestone has been removed by erosion. On the steep slopes considerable damage is caused by washing, deep gullies having been developed in a number of places.

This soil has been derived chiefly from the weathering of sandstone, although, judging from the quantity of chert lying in places upon the surface, it is probable that some material from the limestone rock has been incorporated with

it. Most of the soil derived from sandstone is deficient in lime, but there are some places where wash from higher-lying limestone material has prevented this soil from becoming acid or has corrected acidity. Sorrel grows very generally over both this soil and the loam.

About 30 per cent of this land is cultivated, and the remainder is in forest and permanent pasture. Corn, oats, rye, buckwheat, and some hay are grown, but yields are rather low. The soil is deficient in organic matter, and also in the mineral plant food elements, and requires special treatment to secure best results.

### Boone Fine Sandy Loam, Steep Phase

Boone fine sandy loam, steep phase, includes areas of Boone fine sandy loam which are too steep for successful cultivation under the present system of farming. The soil is similar to typical Boone fine sandy loam, except where erosion has carried away the surface layers. This phase occurs in small, linear, irregular areas associated with Boone fine sandy loam.

The agricultural value of this soil is low, and the best present utilization of it is for forest and pasture land.

### Miami Loam

The cultivated surface soil of Miami loam averages 9 inches in depth and consists of grayish-brown loam containing only a moderate amount of organic matter. The subsoil is usually yellowish-brown loam grading into a gritty clay loam which may take on a reddish-brown color below a depth of 2 feet. Gravel and chert fragments are somewhat abundant in the subsoil and may be present on the surface on knolls and rather steep slopes. The soil varies in texture from silt loam to fine sandy loam, and sandy material may occur in the subsoil. In some places bowlders are present on the surfaces, but not in sufficient numbers to interfere with cultivation.

Miami loam occurs most extensively in Brooklyn township; it also occurs in Albany, Clarno, Decatur, Exeter, and Mount Pleasant townships.

The surface varies from nearly level to rolling, and the

Fig. 5. A view of the Valley of Pecatonica River.

Fig. 6. View of New Glarus where the Swiss made their first settlement.

natural drainage is good although in a few places bordering on the lowlands drainage is slightly deficient.

This soil, like the silt loam, has been derived chiefly from unassorted glacial material of the older Wisconsin or pre-Wisconsin ice sheet. This deposit was thin, and considerable residual material from limestone rock now occurs with the glacial debris, resulting in soils which are partly glacial and partly residual. The soil material has been leached to a considerable extent, and the surface soil in most places shows varying degrees of acidity.

Most of the Miami loam is in farms and is highly improved. The farms are devoted to general farming and dairying, and the chief crops are corn, small grains, and hay. The same cultural methods are followed as on Miami silt loam and Knox silt loam, and suggestions for improvement of those soils will apply equally well to this soil.

### Miami Loam, Steep Phase

The steep phase of Miami loam includes small areas on slopes so steep as to prohibit production of the ordinary cultivated crops of the region, and under present conditions the land is best utilized as pasture.

### Miami Fine Sandy Loam

The surface soil of cultivated Miami fine sandy loam is light brown or grayish-brown to depths varying from 8 to 12 inches. In a few places the texture approaches a fine sand, although in other small areas the material is nearly as heavy as a loam. The subsoil is heavier than the surface soil and usually consists of loam or gritty clay loam material. In some places sandy layers are present in the deep subsoil.

This soil is of small extent, covering only 4.1 square miles, or 2,624 acres within the county. It occurs most extensively in Brooklyn township, and in smaller patches in Albany, Decatur, Exeter, and Clarno townships. The soil is closely associated with other soils of the same series and also with Knox silt loam.

The surface is undulating or gently rolling, and the natural drainage generally good. The soil has developed

largely from the same old glacial debris as Miami loam and Miami silt loam, and it also includes some residual material derived from the underlying limestone. Chert and glacial gravel are common in the subsoil, and on slopes or knolls it may also be present on the surface.

This soil is nearly all in improved farms and is devoted to general farming and dairying. About the same cultural methods and crop rotations are followed as on Miami loam and Miami silt loam. Fine sandy loam soils are considered better adapted to truck crops than Miami silt loam.

## Fox Loam

Fox loam consists of a brown loam which passes at a depth of about 10 inches into a heavy, yellowish-brown loam or light sandy clay loam and grades downward into yellow-brown or brownish-yellow gravelly sandy clay. In general, at depth of 30 inches stratified beds of yellow gravel and sand are encountered although in some places the beds of gravel and sand are within 20 inches of the surface, and in other places they do not occur within a depth of 3 feet. Some areas of Fox silt loam and Fox fine sandy loam, too small to map separately, are included with this soil.

Most of this soil is in the eastern part of the county within the glaciated region, chiefly in the valley of Sugar River in Brooklyn, Exeter, Albany, and Decatur townships. It is associated with other members of the Waukesha series and in places merges into them. Patches of fine sandy loam are included in mapped areas of this phase of Fox loam. In these patches the soil consists of about 10 inches of light-brown or brown fine sandy loam, underlain by pale yellow sandy loam which becomes heavier with depth. The pale yellow subsoil, encountered at a depth of 12 or 14 inches, ranges in texture from heavy fine sandy loam to sandy clay. In some places it prevails to a depth of more than 3 feet, whereas in others a bed of stratified medium and fine sand or gravel is encountered at a depth of 2 or 3 feet.

The surface ranges from almost level to gently sloping or undulating, and the natural drainage is usually good. The soil is open and porous and readily absorbs the normal rainfall.

Nearly all of this land is under cultivation; it is devoted chiefly to corn, oats, barley, rye, and hay. The methods of cultivation followed and the yields secured are similar to those on Fox silt loam. The soil is deficient in organic matter and is somewhat acid.

### FOX FINE SANDY LOAM

The surface soil of Fox fine sandy loam consists of light-brown or grayish-brown fine sandy loam from 6 to 10 inches deep, underlain by a yellowish-brown material of about the same texture. Below 18 inches, a gritty clay loam or sandy clay layer prevails in many places, and at a depth of about 2 feet this grades into stratified sand and gravel.

The soil is somewhat variable, containing small tracts of loamy soil and also some sandy areas. It is confined mainly to the valley of Sugar River. It occurs principally in Brooklyn, Exeter, Albany, and Mount Pleasant townships and is closely associated with Fox loam, silt loam, and sandy loam.

The surface is level, or nearly so, and because of the open nature of the subsoil, it is well drained. The areas are situated well above the present flood plains and seldom suffer from excess water.

This soil has developed from water-laid material and nearly always occurs on terrace formations along streams. The material has been leached to a considerable extent, and the surface soil is usually somewhat acid.

Fox fine sandy loam is a good soil. It is devoted principally to general farming and dairying, corn, oats, and hay being the chief crops.

### WAUKESHA FINE SANDY LOAM

Waukesha fine sandy loam consists of a mellow dark-brown or nearly black loam or fine sandy loam, about 10 inches deep, with a high content of organic matter. The subsoil grades through chocolate-brown loam or fine sandy loam to a yellowish-brown material of about the same texture. At a depth of 2 feet the subsoil is either a gritty clay

loam or sticky sandy loam material and grades into stratified sand and gravel not more than 3 feet below the surface.

This soil is of small extent and is confined chiefly to the eastern part of the county in the valley of Sugar River. The areas are small and widely scattered.

Waukesha fine sandy loam is derived from alluvial deposits laid down by streams when the water was at a much higher level than at present. Although much of the material may have originated from limestone, the soil has been leached to so great an extent that an acid condition has developed. In farming the land, limestone is needed, especially for clover and alfalfa.

Waukesha fine sandy loam is a prairie soil, and the natural growth was largely prairie grasses. Practically all of this soil is now in improved farms and produces fair crops. Corn, hay, and small grains are the chief crops, although the soil is also well suited to special truck crops and would respond well to special fertilization. The improvement of this soil should be conducted along the same lines as the other prairie soils of the county.

# CHAPTER V

## GROUP OF SANDY SOILS

### Waukesha Sandy Loam

Waukesha sandy loam consists of a dark-brown or almost black sandy loam underlain at a depth of 16 or 20 inches by a brownish-yellow sandy clay loam. This becomes lighter in texture with increasing depth and grades into yellowish sandy loam at a depth of about 28 inches. This is underlain by gravelly sand and, at a depth of about 3 feet, by stratified beds of gravel and sand. The topsoil is acid. The surface layer of this soil varies in texture from sand to loam, and the stratified beds of gravel and sand are within 18 inches of the surface in some places and below a depth of 3 feet in others.

This soil is confined to the valley of Sugar River and occurs most extensively in the southeastern part of Decatur township in the vicinity of Brodhead. In fact, the city of Brodhead is situated on a terrace of Waukesha sandy loam.

The surface of this land is level or undulating, and the natural drainage is good, or excessive, because of the coarse open nature of the lower subsoil.

This is an unforested prairie soil, and prairie grasses constituted the native vegetation. Practically all of this land is devoted to general farming in conjunction with dairying. Potatoes are grown more extensively than on the heavier soils, and fair yields are usually obtained. Yields of general farm crops are somewhat lower than on Waukesha loam and Waukesha silt loam, and the soil has lower agricultural value. More tobacco is grown on Waukesha sandy loam than on any other soil in the county. Rye is also grown to a greater extent than on the heavier soils.

## WAUKESHA SAND

The surface soil of Waukesha sand consists of light to dark-brown fine sand, 8 inches deep, which contains only a low percentage of organic matter. This is underlain by a yellowish fine sand which prevails to a depth of 3 or more feet. Some of the soil is coarser in texture, and gravel commonly occurs in the subsoil.

This soil is confined to the valley of Sugar River and is most extensive in the northeastern corner of Spring Grove township. A smaller body is in Decatur township.

The surface of this soil is flat or very gently undulating, but the natural drainage is excessive. Although the water table comes closer to the surface than in the upland soils, this soil is inclined to be droughty.

Most of this land is cleared and under cultivation. The remainder is in brush and second-growth forest and is used to some extent for pasture. Most crops common to the region are grown, but yields are low. Tobacco of fairly good quality is grown to some extent on this soil, although yields are low. The soil is deficient in organic matter as well as in the mineral plant food elements, but the texture of the soil is such that its productivity may be improved.

## FOX SANDY LOAM

The topsoil of Fox sandy loam consists of brown sandy loam of medium texture 8 or 10 inches deep. The soil is somewhat loose and open, and as a rule the supply of organic matter is low. The subsoil is a yellowish sand or sandy loam material which may contain sufficient clay in places to make it somewhat sticky when wet. Below a depth of 2 feet, beds of stratified sand with some fine gravel usually are present. Mapped areas of this type of soil contain patches of Fox loam and fine sandy loam. Where it borders the typical Waukesha sandy loam, it is darker in color than usual and contains more organic matter.

Fox sandy loam is most extensive in the eastern part of the county and is confined chiefly to the valley of Sugar River. It covers a total area of 3.4 square miles and is closely associated with other soil types and soil phases of the Fox series.

The surface of this land is level or gently undulating, and the natural drainage is good, or somewhat excessive. The soil occurs on terraces well above present overflow. The soil material is of alluvial origin; it was probably deposited during glacial periods when much larger quantities of water were carried by the streams than at present. The soil has been leached considerably, and an acid condition prevails.

Fox sandy loam has a somewhat lower agricultural value than Fox loam and silt loam, but it may be considered a fair soil. It is devoted to general farming and dairying, and some tobacco is grown. Corn, rye, and some hay and oats are produced, but yields are lower than on the heavier soils.

## PLAINFIELD SAND

Plainfield soil has a surface soil about 6 inches deep of brown sand of medium texture. It contains only a moderate amount of organic matter and has a loose open structure. The subsoil is light-brown or yellowish medium sand with which there may be mixed a small amount of fine gravel. It is loose and open in structure and very pervious to water. The soil is uniform in texture and color, although in a few places the texture approaches a fine sand, and in others the material is slightly loamy at the surface. Near heavier soils a small amount of clay occurs here and there in the subsoil.

This sand is of very small extent and is confined largely to a few areas in the valley of Sugar River. The largest tracts are in Decatur, Albany, and Exeter townships. A number of smaller tracts are in the eastern part of the county.

The surface of Plainfield sand is level or very gently undulating, and the natural drainage is usually excessive. In many places the soil suffers from lack of moisture during the latter part of the growing season. This soil occurs on terraces or bench land and is well above the present flood plain of streams. It is all of alluvial origin and has been carried and deposited by streams. The material was originally derived in part from sandstone formations, and the surface is usually acid.

Virgin land of this kind was forested with oak and some

pine, but practically all of the timber has been cut and the land placed under cultivation. Most of the general farm crops of the region are grown on this soil, but yields are usually low. The land has a low agricultural value, and lime and commercial fertilizers are needed to improve it.

## COLOMA SAND

Coloma sand consists of light-brown mediums and containing only a small amount of organic matter; it is underlain by yellowish sand of medium texture intermixed with some fine gravel. The sand prevails to a depth of more than 3 feet. This soil is of very small extent, covering less than one-half square mile of land. One small tract occurs in Decatur township, and a few other small tracts are scattered through the eastern half of the county, mostly east of Sugar River. It is a soil derived from glaciated sandstone material which has been affected to some extent by a mixture of material from limestone formations. The soil is acid.

The surface of this land is gently rolling, and the natural drainage is excessive, owing to the loose open character of the soil material and to the surface contour.

This soil is of low agricultural value, differing from Plainfield sand only in the surface configuration. The same crops are grown, and the soil will respond to the treatment suggested for Plainfield sand.

## RODMAN GRAVELLY LOAM

The surface soil of Rodman gravelly loam consists of brown gravelly or sandy loam 8 or 10 inches deep; it is underlain by brownish-yellow sandy or gritty loam which gradually becomes yellowish with depth and is yellowish brown below 15 inches. The gravel content increases with depth, and beds of stratified sand and gravel usually occur about 2 feet below the surface, continuing to undetermined depths. Some gravel appears upon the surface, and glacial bowlders are not uncommon.

The soil is of very small extent and covers a total area of less than one square mile. It is rather widely distributed, however, and is mapped in Decatur, Albany, and Mount

Pleasant townships, with a few other small tracts in the eastern half of the county. It occurs in small patches usually of less than 40 acres and frequently on knolls only a few square rods in extent. It is developed chiefly on kames and eskers whose surfaces are bumpy and irregular, and whose slopes are usually steep and seldom cultivated. These hillocks occur in groups, and areas of the Rodman soil are separated by patches of Miami silt loam. Because of the rough surface and the gravelly nature of the subsoil, this soil is well drained, and where the soil is shallow, the drainage is excessive.

Some of the areas are forested, mostly with oak; others are used for pasture land. This land can best be utilized for pasture since most of it is too steep to be used for cultivated crops.

Being underlain by deposits of gravel, this soil is the source of supply for gravel for road building. Good quality gravel for road construction enhances the value of this land.

Fig. 7. A few trees are needed for shade, but a good woodlot cannot be maintained if cattle are allowed to roam through it at will, destroying seedlings.

# CHAPTER VI

## GROUP OF POORLY DRAINED SOILS

### CLYDE SILT LOAM

Clyde silt loam may consist of a 12 or 14 inch layer of dark-brown or black silt loam, very high in organic matter and underlain by a subsoil of dark-gray silt loam material mottled with drab and yellow. At a depth of about 24 inches the material is mottled brownish-yellow or drab silty clay loam material which may continue to a depth of 3 or more feet.

This soil as mapped is not uniform. In many places the first 8 inch layer consists of peaty material. In flood-plain areas a layer of peaty material, from 1 to 10 inches thick, may occur in either the upper or lower part of the subsoil. Here and there along streams, black silt loam has been deposited over loam and fine sandy loam; in other places the surface material, to depths ranging from 1 to 10 inches, is a light-brown silt loam, underlain by black silt loam or peaty silt loam material made up of wash from adjoining high land. The uniform features of this soil are poor drainage, dark color, and high content of organic matter. Much of the parent material has been deposited by water or has been modified to some extent by water action since its deposition by other agencies. The Clyde soils are confined to the region influenced by glacial ice. Since most of the material came originally from limestone, the soils are not usually acid, and as the waters draining into the lowlands usually carry some lime from the higher lands adjoining, the soil material is somewhat calcareous.

Clyde silt loam is developed most extensively in the eastern part of the county and is confined chiefly to the valley of Sugar River and its tributaries. The largest areas are in Brooklyn, Exeter, Albany, Decatur, Spring Grove, and Sylvester townships.

The surface of this soil is low-lying, flat, or basinlike, and the natural drainage poor. The land usually has a very slight slope toward the drainage way along which it occurs.

The original forest growth consisted of elm, ash, soft maple, willow, some sycamore, and some bur oak. Most of the merchantable timber has been cut, but in a few places where the land has not been drained, timber of good quality is still standing.

Some of this soil has been reclaimed by drainage, but the major part of it is too wet for the successful production of cultivated crops. With proper drainage, however, this would be one of the best corn soils in Wisconsin, and on drained areas corn is the chief crop, although hay is also extensively grown. Alsike and timothy are the most common hay grasses.

This soil is also well suited to sugar beets and to cabbage, but these crops are grown but little. Small grains make a rank growth but are likely to lodge, and the quality of the grain is never so good as on the light colored heavy upland soils.

## CLYDE LOAM

The surface soil of Clyde loam has a depth of about 12 inches and consists of black or nearly black loam or fine sandy loam which contains a high percentage of organic matter or humus. The subsoil is variable in texture, but it is usually lighter in color than the surface soil. In many places it consists of drab or bluish loam or fine sandy loam material which may become a silty clay loam or sticky sandy clay at a depth of 18 inches. The deep subsoil may contain considerable sand, and stratified material occurs in many places below a depth of 2 feet.

Clyde loam is confined largely to the eastern part of the county, chiefly to the valley of Sugar River in Brooklyn, Exeter, Albany, and Decatur townships. Other small areas are in some of the adjoining townships. The total area is only 1,216 acres.

The soil is low, the surface is level or slightly depressed, and the natural drainage is poor, although the land is seldom flooded. It is usually on low, poorly drained terraces,

although in a few places it comprises depressions in the upland.

This soil is of little agricultural importance because of its small extent. Most of it is undrained, and it is utilized chiefly for pasture. When thoroughly drained, it will make excellent farm land well suited to corn, grass, and hay, as well as to truck crops.

## WABASH SILT LOAM

The surface soil of Wabash silt loam has a depth of about 14 inches and consists of black or dark-brown silt loam containing a high percentage of organic matter. It is underlain by brownish-drab or bluish silt loam, or silty clay loam material, which is mottled with iron stains below a depth of 18 inches. This material prevails to a depth of more than 3 feet and usually becomes heavier in texture with depth. Variations in this soil are common, occurring especially along the smaller streams. In some places the black surface soil continues to a depth of more than 2 feet; in other places the surface soil is light brown, and the black silt loam occurs a few inches below the surface; in still other localities there is a peaty covering, a few inches deep, over the silt loam; and in some small patches both soil and subsoil are somewhat sandy. All these variations mentioned are of such small extent that they could not be indicated on the soil map. The soil is usually slightly acid.

This soil is developed along practically all streams and comprises the most extensive first-bottom land in the county. The largest tracts occur along Sugar River in Spring Grove, Decatur, Albany, Brooklyn, and Exeter townships, and also along the smaller tributary streams, such as Jordan Creek and Little Sugar River. In the western and southwestern parts of the county it occurs along Pecatonica River and its tributaries.

The surface of the land is level, or gently sloping toward the stream; it is subject to overflow and the natural drainage is poor. Before cultivated crops can be grown successfully, much of the land will require tiling.

Wabash silt loam is of alluvial origin, the alluvium having been washed from the adjoining higher land, carried by

the streams, and deposited within the present flood plain. The decay of rank vegetation developed under moist conditions accounts for the dark color and the high organic matter content of the soil. In some of the narrow valleys it is partly colluvial in origin.

The original forest growth consisted of willow, sycamore, elm, soft maple, and ash. Some of the timber is still standing, but the best has been cut.

On account of the poor drainage and the danger from overflow, this soil is not used extensively for farming. It affords good pasturage, however, and is highly prized for this purpose where dairying is carried on extensively. In a few places where the soil is properly drained, crops yield well, corn averaging as much as 60 bushels an acre. The chief need of this land is drainage, and with the construction of open ditches and tile drains, it should become one of the most productive soils of the county.

### WABASH SILT LOAM, BETTER DRAINED PHASE

The areas of Wabash silt loam which have better drainage than the typical soil are mapped as a better drained phase. Most of this land occurs along intermittent streams where there is less danger from flooding, and where much of the land can be cultivated without tiling. The soil is partly colluvial and partly alluvial, and in some places extends up the lower slopes for a short distance so that the natural drainage is fair. The soil is practically the same as typical Wabash silt loam, but the black surface layer frequently continues to a depth of 2 or 3 feet where wash from adjoining dark-colored upland soils has accumulated. This land is excellent, and parts of it are in cultivated crops each year.

### WABASH LOAM

The topsoil of Wabash loam has an average depth of 14 inches and consists of dark-brown or black loam. The subsoil usually is a drab or somewhat bluish loam or fine sandy loam material mottled with yellow in the lower part. The soil is extremely variable and in some places the surface soil has a fine sandy loam texture; but because of its small

although in a few places it comprises depressions in the upland.

This soil is of little agricultural importance because of its small extent. Most of it is undrained, and it is utilized chiefly for pasture. When thoroughly drained, it will make excellent farm land well suited to corn, grass, and hay, as well as to truck crops.

### WABASH SILT LOAM

The surface soil of Wabash silt loam has a depth of about 14 inches and consists of black or dark-brown silt loam containing a high percentage of organic matter. It is underlain by brownish-drab or bluish silt loam, or silty clay loam material, which is mottled with iron stains below a depth of 18 inches. This material prevails to a depth of more than 3 feet and usually becomes heavier in texture with depth. Variations in this soil are common, occurring especially along the smaller streams. In some places the black surface soil continues to a depth of more than 2 feet; in other places the surface soil is light brown, and the black silt loam occurs a few inches below the surface; in still other localities there is a peaty covering, a few inches deep, over the silt loam; and in some small patches both soil and subsoil are somewhat sandy. All these variations mentioned are of such small extent that they could not be indicated on the soil map. The soil is usually slightly acid.

This soil is developed along practically all streams and comprises the most extensive first-bottom land in the county. The largest tracts occur along Sugar River in Spring Grove, Decatur, Albany, Brooklyn, and Exeter townships, and also along the smaller tributary streams, such as Jordan Creek and Little Sugar River. In the western and southwestern parts of the county it occurs along Pecatonica River and its tributaries.

The surface of the land is level, or gently sloping toward the stream; it is subject to overflow and the natural drainage is poor. Before cultivated crops can be grown successfully, much of the land will require tiling.

Wabash silt loam is of alluvial origin, the alluvium having been washed from the adjoining higher land, carried by

the streams, and deposited within the present flood plain. The decay of rank vegetation developed under moist conditions accounts for the dark color and the high organic matter content of the soil. In some of the narrow valleys it is partly colluvial in origin.

The original forest growth consisted of willow, sycamore, elm, soft maple, and ash. Some of the timber is still standing, but the best has been cut.

On account of the poor drainage and the danger from overflow, this soil is not used extensively for farming. It affords good pasturage, however, and is highly prized for this purpose where dairying is carried on extensively. In a few places where the soil is properly drained, crops yield well, corn averaging as much as 60 bushels an acre. The chief need of this land is drainage, and with the construction of open ditches and tile drains, it should become one of the most productive soils of the county.

### Wabash Silt Loam, Better Drained Phase

The areas of Wabash silt loam which have better drainage than the typical soil are mapped as a better drained phase. Most of this land occurs along intermittent streams where there is less danger from flooding, and where much of the land can be cultivated without tiling. The soil is partly colluvial and partly alluvial, and in some places extends up the lower slopes for a short distance so that the natural drainage is fair. The soil is practically the same as typical Wabash silt loam, but the black surface layer frequently continues to a depth of 2 or 3 feet where wash from adjoining dark-colored upland soils has accumulated. This land is excellent, and parts of it are in cultivated crops each year.

### Wabash Loam

The topsoil of Wabash loam has an average depth of 14 inches and consists of dark-brown or black loam. The subsoil usually is a drab or somewhat bluish loam or fine sandy loam material mottled with yellow in the lower part. The soil is extremely variable and in some places the surface soil has a fine sandy loam texture; but because of its small

extent and variability, this soil was mapped with the loam. There is a thin covering of peat over the surface in places, and fine gravel frequently occurs in the lower subsoil.

This soil is developed along the first bottoms of streams, most of it in the valley of Sugar River in the eastern part of the county. It is of much smaller extent than Wabash silt loam and of minor importance.

The surface of this land is low and flat, or it has only a gentle slope toward the stream along which it occurs, and the natural drainage is poor. The land lies within present flood plains and is subject to overflow. The moist conditions have favored a rank growth of vegetation, the decay of which accounts for the dark color of the soil. The original growth, in addition to grasses, consisted chiefly of elm, ash, soft maple, and willow.

On account of its low position, poorly drained condition, and the danger from floods, this soil is used only for pasturage and to a small extent for marsh hay. If drained, this soil would be suited to the same crops as Wabash silt loam and it may be managed in the same way. In its present condition its use as pasture land is probably the most practicable. Draining and protecting the land from floods are the first steps necessary in improving this soil.

## PEAT

Peat, as mapped In Green County, consists of vegetable matter in various stages of decomposition mingled with varying proportions of mineral matter. It consists of black or dark brown, fibrous or finely divided vegetable matter, mixed with a small amount of fine sand and silt. It ranges in depth from 1½ to 10 feet but averages 4 feet. Most of the peat is fairly well decomposed and when dry resembles a black, carbonaceous clay. In areas of sandy soils, peat is generally underlain by sandy material, whereas in regions of heavy upland soils the underlying material is clayey. Most of the peat in Green County is underlain by material as heavy as, or heavier than, loam.

Peat is widely distributed in Green County; it is mapped in nearly every township and occurs in every tract ranging from a few acres to one-half square mile or more in

extent. In many cases peat occurs in long narrow strips along stream channels; in fact most of the peat is found in in such places; and only a small proportion occurs as depressions in the upland old lake, and pond beds as it is very scarce in this old glacial region of the pre-Wisconsin drift. It is most extensively developed in the valley of Sugar River and its tributaries in Decatur, Albany, Brooklyn, Exeter, and New Glarus townships; and some is mapped along Pecatonica River and its branches in the southwestern part of the county.

The surface is low, level, and very poorly drained. During early spring some of the marshes are entirely covered with water, but later in the summer many areas of peat are dry and firm so that they can be used for pasture, or the wild grasses cut for hay.

Peat has been formed through the growth and partial decomposition of a rank vegetation in the presence of water. Around the margins of the larger marshes, and over the greater part of the smaller ones, varying quantities of mineral soil from the adjoining higher land have been washed in and incorporated with the vegetable matter. Although most of the peat occurs within the region where the upland soils are partly made up of limestone material, some of it, particularly in the larger marshes, is acid.

The native growth in these marshes consists of several varieties of grasses and sedges, arrowhead, cattail, various reeds and rushes, and sphagnum moss. Tamarack grows in a few marshes.

Only a few of the peat beds have been ditched and reclaimed but, where thoroughly drained and properly handled, they produce good yields of corn, mixed timothy and alsike hay, oats, potatoes, onions, celery, and cabbage.

### PEAT, SHALLOW PHASE

The shallow phase of peat consists of black or dark-brown vegetable matter in varying stages of decomposition, ranging in depth from 8 to 18 inches, and mixed with more or less sand, silt, or clay.

The shallow peat is much less extensive than the other; it occurs chiefly in Albany, Brooklyn, and Exeter townships,

in association with the deeper peat and soils of the Clyde series. It covers a total area of 640 acres. It is similar, in topography, drainage, and character of vegetation, to typical peat, although some of the marshes are underlain with clay, clay loam, or silt loam at a depth of only 12 or 15 inches.

# CHAPTER VII

# AGRICULTURAL DEVELOPMENT OF GREEN COUNTY

## HISTORY OF SETTLEMENT, TRANSPORTATION, AND MARKETS

Early settlement in Green County was stimulated by mineral deposits which were thought to exist in this region. The first settlement is reported to have been made in 1828 at Sugar River Diggings, located near Sugar River in Exeter township. Green County was organized in 1836, at which time it was separated from Iowa county. The first important industry to receive attention was the mining of lead and zinc, but larger mines were located in adjoining counties, and the mines in Green County were soon exhausted. Following the early mining activities, agriculture was given more attention, and the region early became a thriving agricultural community.

The first extensive agricultural development in Green County was made by a colony of Swiss who settled at New Glarus and developed one of the most prosperous agricultural communities in the United States.

The population of the county in 1920 was 21,568. It is well distributed over the entire county. Of the total population, 3,187, or 14.8 per cent, are foreign-born white people. Monroe, the county seat, has a population of 4,788. Other important railway and shipping points within the county are Browntown, Martintown, Monticello, New Glarus, Belleville (partly in Dane County), Albany, Brodhead, and Juda.

The county is fairly well supplied with railroads. Most farms are within 10 miles of a shipping point. Dirt roads are for the most part good when they are kept graded, and several State Trunk highways, kept in excellent condition, cross the county.

In the earliest settlement of Green County, wheat was grown exclusively and continuously for several years by the Swiss settlers until some of the land was practically worn out. Not until then did they turn to dairying which

has since become the principal industry. Dairying is carried on in all parts of Green County. It is by far the most important enterprise conducted in the region although general farming is also engaged in by most farmers.

With the development of dairying came a more diversified system of cropping. The acreage of wheat was greatly reduced, and the acreage in hay and corn increased. Small grains are grown on nearly every farm. However, on the gently rolling prairie lands throughout the county and on the smoother lands in the eastern part of the county, there is a larger acreage of corn, oats, and barley than in the western part where the slopes are steep and where there is more danger of washing in cultivated fields. On the other hand, more land is in pastures in the steeper parts of the county. Adams township has more pasture land than Washington township, for Adams township is more rolling and has much more steep land than Washington township. In Spring Grove township and also in other townships traversed by Sugar River, pasture land is low wet land rather than steep land.

Tobacco farming is a special industry followed to a small extent in this county, but it is confined almost entirely to sandy soils in Decatur and Brooklyn townships. Potatoes are also grown in the eastern part of the county and in other areas of sandy soils.

## Farm Products and Agricultural Statistics

Of the farm crops grown in Green County the cereals, including corn, lead in acreage and value. The total value of all cereals grown in the area in 1919, as given by the census was $3,861,645. This represented approximately half of the value of all crops in that year. Hay and forage crops had a total value of $3,699,932. The value of the dairy products produced in the county in 1919 amounted to $5,585,782.

The following table, taken from the census reports, gives the acreage and production of the leading crops for five census years. This table shows the importance of the various crops and the changes in acreages of the different crops during the last forty years.

ACREAGE AND PRODUCTION OF THE PRINCIPAL CROPS IN GREEN COUNTY FOR FIVE CENSUS YEARS

| Crops | 1879 | | 1889 | | 1899 | | 1909 | | 1919 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Acres | Tons | Acres | Tons | Acres | Tons | Acres | Tons | Acres | Tons |
| Hay and forage | 44,390 | 67,252 | 56,516 | 88,705 | 47,797 | 63,978 | 58,022 | 96,685 | 88,283 | 281,090 |
| | | Bushels | | Bushels | | Bushels | | Bushels | | Bushels |
| Oats | 37,166 | 1,348,942 | 44,832 | 1,829,351 | 55,628 | 2,116,250 | 35,421 | 1,147,266 | 40,916 | 1,355,532 |
| Corn | 59,745 | 2,187,550 | 52,399 | 1,595,922 | 68,162 | 2,692,680 | 56,915 | 1,880,987 | 34,664 | 1,401,880 |
| Rye | 3,384 | 51,100 | 4,011 | 65,322 | 2,907 | 40,860 | 892 | 11,429 | 1,511 | 19,763 |
| Barley | 635 | 12,544 | 1,180 | 37,055 | 2,516 | 79,460 | 14,132 | 368,636 | 12,303 | 345,603 |
| Wheat | 11,774 | 192,983 | 2,859 | 33,568 | 1,191 | 21,790 | 494 | 10,187 | 4,802 | 70,031 |
| Potatoes | ............ | 142,103 | 1,693 | 158,033 | 1,354 | 151,270 | 1,163 | 121,365 | 889 | 44,836 |
| | | Pounds | | Pounds | | Pounds | | Pounds | | Pounds |
| Tobacco | 122 | 117,571 | 243 | 277,703 | 323 | 419,470 | 257 | 294,210 | 91 | 110,048 |

## Agricultural Data

In 1928, there were in Green County 63,900 cattle. Of this number there were 46,200 producing cows. The average production per cow in 1927 was 5,800 pounds of milk. By far the greater proportion of the dairy products are sold in the form of cheese. In 1925 there were 15,912,320 pounds of cheese produced in Green County. Of this more than 7,000,000 pounds were Swiss cheese, 4,251,680 pounds were Limburger, more than 3,000,000 pounds were brick cheese, and more than 1,000,000 pounds were American cheese. There were, in 1926, 143 cheese factories and 6 creameries, and 24 receiving stations in the county.

Butter produced in creameries amounted to 167,977 pounds.

There were in the county in 1927 a total of 2,116 silos. A number of farms have two silos.

In connection with the dairy industry the growing of alfalfa is receiving considerable attention. In 1927, there were 13,600 acres devoted to this crop. In 1927, there were 63,970 acres devoted to corn, and of this acreage 33,910 acres were for the silo. That same year oats had an acreage of 42,540 acres, and barley was grown on 13,590 acres. All tame hay covered an acreage of 62,271 acres, while of this acreage clover and timothy covered 46,760 acres. Special crops are not grown to any extent. There were in 1927 about 110 acres of tobacco and 20 acres of canning peas.

## Adaptation of Crops to Soils

Farmers in general recognize that certain crops are best adapted to certain soils. In this county the light colored heavy upland soils are well adapted to the production of small grains as well as to grasses. A better quality of grain is produced here than on the black soils, and danger from lodging is not so great. The black prairie land, having an undulating or gently rolling surface, and the drained, heavy, black lowland soils are well suited to corn. Rye is grown most extensively on soils of light texture, and in Green County tobacco also is usually grown on light soils, chiefly in the vicinity of Brodhead. Tame hay is grown on

all kinds of soils, but it makes its best growth on the heavy soils. Clover and alfalfa do best where the supply of lime in the soil is greatest.

Although soils influence considerably the crops which can be grown to best advantage, topography is a very important factor in the selection of crops to be grown and the farming methods followed.

The largest acreage of corn is grown in Spring Grove township where there is much reclaimed lowland and also extensive tracts of heavy upland where the surface is gently rolling and not too steep for the cultivation of corn. There is also considerable gently rolling prairie land in this township. Decatur township was second in acreage of corn. This township contains part of Jòrdan Prairie which is excellent cornland, and very little of the township is rough and steep. Clarno township, producing 4,755 acres of corn, occupies high, rolling land, much of which is prairie. On the other hand, in New Glarus township where there is much steep land, only 2,571 acres of corn were grown, the least in any township of the county and less than half the ácreage grown in Spring Grove township. These differences are due chiefly to the marked differences in topography.

The effect of topographic difference is particularly evident on pasture land, especially the pasture land which is not plowed, as this includes most of the steepest land in the county.

## Farm Equipment

Farm buildings and equipment in Green County are in general of very high grade and reflect the prosperity of the farmers. Barns are large, well constructed, and designed to provide roomy, comfortable quarters for dairy cattle. In 1927, there were 2,116 silos in the county on a total of 2,330 farms.

Tractors are coming into common use, and, although they are not used so generally as in more level regions, there is a total of 354 tractors in the county. Tractors are least used in sandy and extremely rough parts of the county; they are most common in Spring Grove township where there is considerable fairly smooth prairie land.

Farmhouses are well built, especially where the dairy industry is most highly developed. They are kept in good repair, and many are supplied with such modern conveniences as electric lights, modern heating plants, and running water. Practically all farms have rural mail service, telephone service, and most of the farmers own automobiles.

## FARM TENURE AND LABOR

According to the 1920 census, 1,694, or 72.7 per cent, of the 2,330 farms in Green County were operated by the owners; 601 farms, or 25.8 per cent, were operated by tenants; and 35 farms by managers. Of the 601 tenant farmers, 413 were share tenants, 180 were cash tenants, and 8 were classed as share-cash tenants. Farms comprise 90.8 per cent of the land area of the county, and 78.6 per cent of this farm land is improved.

## LAND VALUES

The value of farm lands in Wisconsin was not inflated so greatly during the war period as it was in some other parts of the Middle West, and as a result the decline in land values has been moderate.

The census of 1920 reported that the average value of land and buildings to the farm in Green County was $23,784. Thus, the average farm of 148 acres had a value of about $160 an acre. The average value of the land alone is given as $127.91 an acre.

1 sheet